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CIVIL ENGINEERING

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POWER TUNNEL, APALACHIA PROJECT, TVA—EAST PORTAL AT TURTLETOWN CREEK, WITH MUCK BRIDGE IN FOREGROUND (SEE ARTICLE, PAGE 5)

Volume 15 — *Number 1*

JANUARY 1945

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Among Our Writers

STUART C. GODFREY (U.S. Military Academy; Army War College; Command and General Staff School) in his Army service includes a year with the A.E.F. in France, 1918–1919; Engineer for the Army Air Force Combat Command; and at present, Brigadier General, U.S. Army, in the China-Burma-India Air Service Command.

GEORGE K. LEONARD (U. of Nebr., B.Sc. C.E. '12, C.E. '39) has been connected with construction for 30 years. Prior to 1933 he was contracting engineer and general construction superintendent for Woods Bros. Const. Co. Since that time he has been with TVA as Construction Engineer on Wheeler, Guntersville, Watts Bar, and Cherokee dams and Project Manager of Hiwassee Projects, including Apalachia, Ocoee, Chatuge, etc.

A. PRESCOTT FOLWELL (Brown U., A.B. '85; M.I.T., '88; Lafayette College, Sc.D.) had 10 years of early experience in canal, sewerage, and water supply engineering, followed by 10 years of teaching at Lafayette College. Since 1906, he has been editor of *Public Works*. He is the author of several well-known volumes.

JAMES B. FRENCH (Cornell, C.E. '85) had early experience on railroad and bridge work, then served as Bridge Engineer for the C. & O. Ry. and later for the Long Island R.R. From 1908 to 1939 he was consulting engineer for the principal trunkline railroads entering New York harbor and for railroad contractors.

ANDREW J. PROVOST, JR. (Columbia College, C.E. '89) spent 17 years in municipal engineering for the cities of Brooklyn and New York. Since 1907 he has been in private practice, specializing in water supply, sewerage, and public health.

T. KENNARD THOMSON (U. of Toronto, C.E. '92, D.Sc. '13) following early bridge and railroad work, was for 9 years chief engineer of Arthur McMullen & Co., general contractors. He then went into consulting practice, working on over 60 buildings and many bridges—specializing in foundations and caissons. He is the author of numerous articles in engineering publications.

JOSEPH D. LEWIN (Tech. Universities: Karlsruhe, B.S. '30; Paris, C.E. '32; Berlin, M.S. '33) has worked on hydroelectric developments in Europe and on design for Phoenix Engineering Corp. He has been with the Corps of Engineers and with the New York Board of Water Supply. He is now doing consulting work on a $48,000,000 steel-mill project for South America.

CECIL K. OAKES (La. State U., B.S. in C.E. '31) has had 6 years with the U.S. Engineer Dept. on hydraulic studies and design, on flood control and airfield and cantonment drainage; and 2 years with The Panama Canal on flood control and hydraulic design of drainage structures.

RUSSELL B. JAMES is a Chicago lawyer, whose practice relates largely to public utility regulation and aspects of administrative law. A number of articles written by him have appeared in legal periodicals. He is a graduate of the U. of Mich.

J. R. CHARLES (Walsall Tech. Col. '25; Nat'l. Diploma in Mech. Eng., London U. '30) was in charge of important work in the chemical field for 3 British firms before becoming chief engineer of Magnesium Elektron Ltd. in 1936. He was loaned to Basic Magnesium, Inc., at request of U. S. Government, 1941 to 1943.

DAVID ANDERSON (St. Andrews U.) senior partner in the firm of Mott, Hay and Anderson, London, England, has been in charge of the design and construction of Mersey Tunnel and other notable British structures. With his partners, he is consulting engineer to the Central London Ry.

EDWARD W. BUSH (Penna. State College, B.S. and C.E.) is the author of many articles discussing the economical way of letting contracts, the relations between contractors and engineers, etc., based on his 25 years of experience on large construction jobs, followed by an equal period as the engineer of a surety company.

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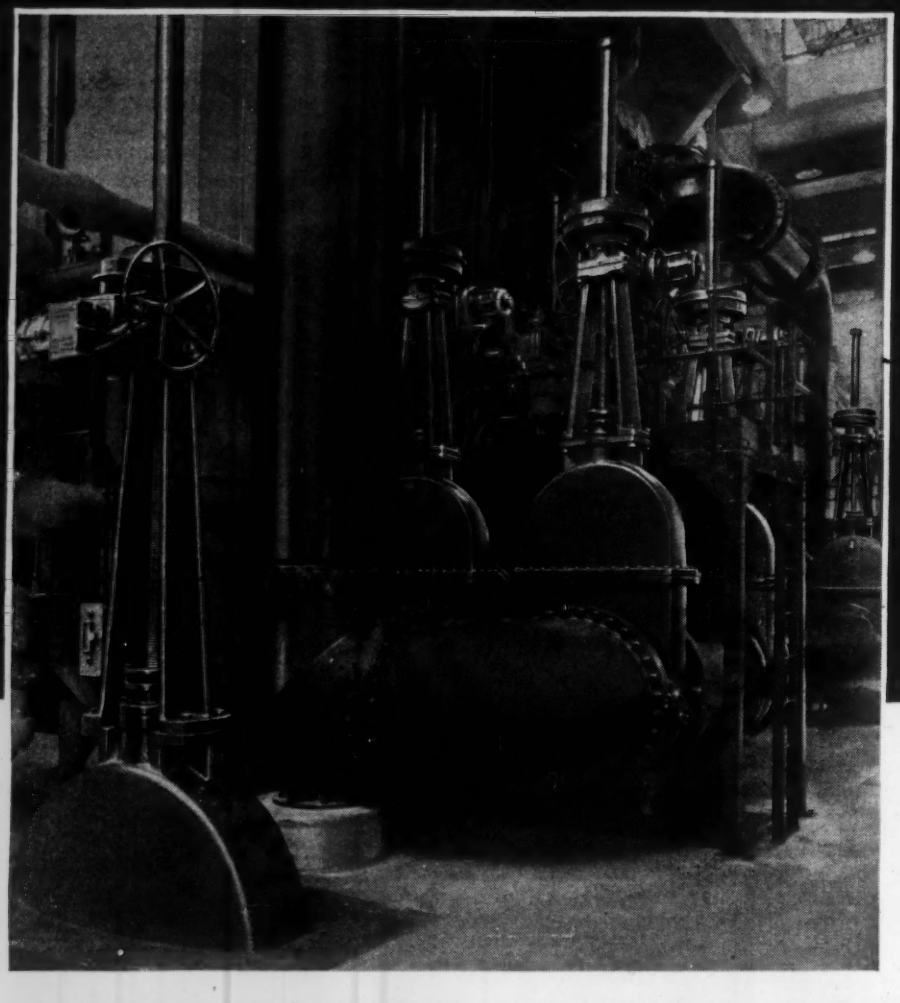

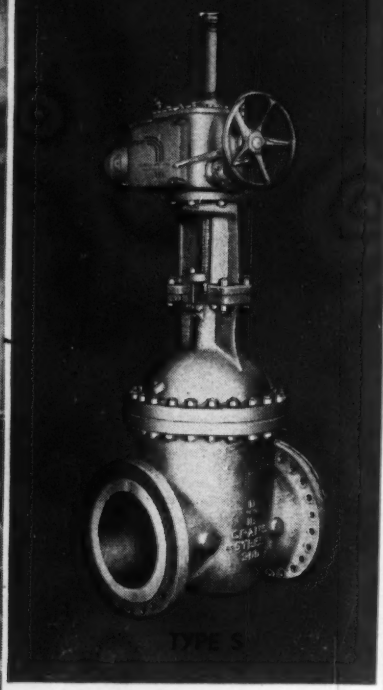

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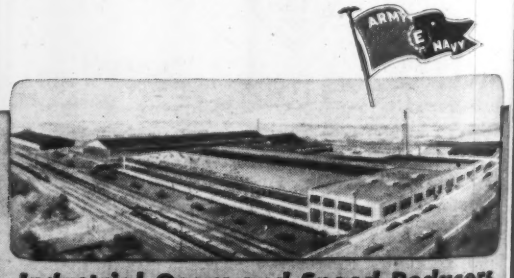

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Airfields Constructed in the Far East

I. Age-Old Methods Combined with Newest to Provide Military Fields

By STUART C. GODFREY, M. AM. SOC. C.E.
BRIGADIER GENERAL, U.S. ARMY, AIR ENGINEER, CHINA-BURMA-INDIA AIR SERVICE COMMAND

CONSTRUCTION of military airfields has been an engineering task of first priority in most overseas theaters. As one air commander writes, "It may be that we will find that construction of airdromes will be one of the major elements in winning the war in this theater." From the Far East, General Godfrey has sent this story of the airfield problems in India, China, and Burma. The role of the Aviation Engineers in finding widely different solutions to puzzling problems is apparent. In the January 1943 issue of "Civil Engineering" General Godfrey described the organization, training, and activities of the Aviation Engineers. A second part of the present article will follow in the February issue.

HALFWAY round the world from the United States lie the India-Burma and the China theaters of operations—strangest as well as most distant of all the areas in which our troops are engaged. Unusual are some of the engineering construction problems that have been presented—and the solutions that have been evolved—including the age-old ways of the East and some new techniques of the West. As Air Engineer, with general supervision for the U.S. Army Air Forces over their program of airfield construction, I have been on duty in the Far East for nearly a year, and believe that these descriptive notes on activities there may be of timely interest to readers of CIVIL ENGINEERING.

Sprawling from west to east, the two theaters, which until recently were one theater under a single command, span a distance equal roughly to that across the United States. Their size and extent can be better judged, in fact, by imagining a map of the Far East superimposed on a map of the United States and vicinity, so that the east and west coast lines more or less coincide. Karachi, the usual port of entry to India by air, thus falls near San Francisco, with the larger port of Bombay to the south (corresponding to Los Angeles).

Proceeding east across India, we pass New Delhi (Elko, Nev.), capital of India and headquarters of General Sultan and the India-Burma theater; and Calcutta (Albuquerque, N.Mex.), second city in the British Empire, first port of India, headquarters of General Stratemeyer and our Army Air Forces in India-Burma. Far to the south is Kandy, Ceylon (tip of Lower California), whence Admiral Mountbatten administers the South East Asia Command.

For a landmark in Burma we may take battle-scarred Myitkyina (Wichita, Kans.) captured by Stilwell in July after the brilliant dash of Merrill's Marauders.

Passing on over "the Hump" to China, we may note Kunming (St. Louis, Mo.), a 14th Air Force base; Chungking (Chicago), capital of China and headquarters of General Wedemeyer and the China theater; Kweilin (Knoxville, Tenn.), now a part of Japanese occupied China; Shanghai (Boston, Mass.), on the Pacific Coast. And if you care to keep going, there's Tokyo, Japan, at a spot corresponding to St. Johns, Newfoundland.

But this comparison as to distances in North America must be made with one important reservation—the road net and the character of communications we enjoy at home must be forgotten. It would be possible to make the journey by air in a day. But via the railroads of India, the roads of China, and hiking on foot over the Hump, three months would be a fair allowance to accomplish it. True, India's railroads total an impressive mileage, but are of different gages and indifferent service. In China, transportation problems—considering the poor roads, shortage of trucks, and critical shortage of gasoline—are even more acute. And in between lies the formidable barrier of the Hump, untraversed as yet by any road available to the Allies.

Hence the initial and still continuing problems of these theaters have revolved to a large extent around questions of supply, of ports and routes of communication, of pipe lines and the Ledo Road. In meeting these problems during the past three years, our Services of Supply have made notable progress.

As for the climate of tropical India, no one likes it. Intense heat and heavy rains for six months, the constant

AIR-BORNE ENGINEERS IN BURMA WERE SUPPLIED WITH HEAVY EQUIPMENT BY AIR

WHEN THE AVIATION ENGINEERS ARRIVED, DRIBLETS OF CONCRETE WERE BEING CARRIED TO FORMS IN HEAD TRAYS

threat of malaria and dysentery and other tropical illnesses—these do not constitute a pleasant régime, unless one can in summer escape from the lowlands into the hills. China enjoys a more variable and temperate climate. Burma is between the two extremes, and like India has its monsoons that make road and airfield building a nightmare at times.

The airfields of India have been built primarily by the British, for the British—but with an increasing number diverted wholly or partly to the use of U.S. Army Air Forces. At Karachi, Delhi, Calcutta, and other cities, the visitor finds airfields with passenger terminals and concrete runways generally comparable to our commercial airfields at home. Furthermore, India in general has a fairly imposing network of military airfields. These too have concrete runways, usually 6,000 ft in length. Their well-dispersed pattern, dictated by military considerations, provides for taxiways leading to hard standings, with living accommodations well away from the technical area.

The prevalence of concrete would seem to imply modern construction practice, but the visitor gets a surprise when he sees a runway actually under construction—a task performed usually by Indian contractors and laborers. Perhaps one or two small mixers are in evidence; perhaps again the mixing is being done by hand. In any event, the concrete moves to the forms in driblets. From mixing point to form extends a procession of laborers, men or women, each bearing on his head a tray containing a small dab of concrete. Slowly the line moves forward at the leisurely pace of the East. If the haul is of any length, the tray may be transferred several times en route, as the bearer seems to tire after a short period.

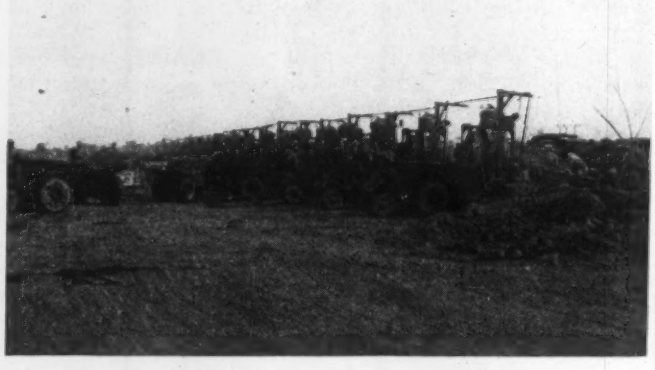
Naturally the quality of concrete produced in this way leaves much to be desired. Concrete slabs are, moreover, thinner than is standard practice with us, and are placed on a "soling" (of what we would term hand-placed, one-man stone) or directly on a soil which may, or may not be, well compacted. In a country which during the monsoon months is subjected to heavy and frequent rains, one would expect particularly careful attention to drainage. Such care has not been exercised in many cases, however, either in the choice of location or in the use of adequate crowns to shed water and ditches to carry it off. Heavy maintenance is the rule. Nor does the use of brick for runways in lieu of concrete—in delta areas where rock aggregate is not readily available—prove a very satisfactory substitute.

The Indian laborer is paid on the average about 30 cents a day; thus labor is cheap, but it is far from efficient. Nor in certain parts of India is the number of available laborers adequate—strange to say in a land of 400,000,000 people. The difficulty stems from the fact that airfield and other special construction makes inroads on the laborers normally employed in rice fields, in tea gardens, in mines and other industries.

Building construction ranges all the way from *pucca* through *basha* to *busti*. *Pucca* is the best type of construction, involving the use of brick, tile, frame timber, and the like. *Basha* is a cheaper grade of construction utilizing poles, woven bamboo walls, and thatched roofs. (The Indians make ingenious use of bamboo in a score of ways.) *Busti* refers to an even flimsier type of structure. The tendency is towards *basha* (or to tents) for, as with us, effort is increasingly made to keep construction to bare essentials, even in the Zone of the Interior. Building construction proceeds slowly and still savors of primitive methods. One sees Indian carpenters with bow drills instead of augurs.

To the Americans who came over in 1942, to our Air Forces keen for action, it can be well imagined that the situation left much to be desired. In Eastern India there were few airfields well located for offensive operations, while North Eastern Assam, where the take-off fields were needed for the air lift over the Hump, was a quiet, rural, tea-growing province. These Americans, who wanted results in a hurry and were used to getting them, were hard to satisfy.

The British, despite lack of heavy equipment and other handicaps, did their best. Gradually a chain of American airfields across India took shape. The conversion of



BATTERIES OF CONCRETE MIXERS SPRANG UP WHERE BEFORE A SOLITARY MIXER HAD CHUGGED

northeast Assam into a hive of activity, with busy airfields, well-stocked depots, heavily traveled roads in place of tea-garden lanes, constituted a major transformation. One enterprising U.S. Engineer, charged with reconnoitering for a fighter field for one of our early P-40 squadrons, rented an elephant, parked on top of which he could negotiate the sodden soil and observe above the 7-ft-high grass. The tea-growers themselves turned out with their coolies, and worked magnificently.

Not until early in 1944 was it practicable to employ any appreciable number of U.S. engineer troops on airdrome construction in India. The urgent need for a certain group of airfields on which to base our new superbombers was responsible for the presence of these troops, with their fine equipment. Work was started on these fields by British engineers and Indian contractors in the traditional manner. The British assisted to their utmost in this project, turning over to us some of their best fields for the purpose. They began work quickly, before U.S. Aviation Engineers could be transported to India,

in some cases finished the 1,500-ft concrete extensions to existing runways. While U.S. resources were tapped for many prefabricated buildings, hangars and the like, much native-type construction was also needed, which the British services accomplished.

Later the U.S. aviation engineer troops arrived and went into action alongside the Indian labor. Batteries of concrete mixers sprang up where before a solitary mixer had chugged along. Earth was moved by the yardful instead of the trayful. Concrete slabs were thicker and stronger, for these particular runways had to be able to support a load of well over 120,000 lb. By June these airfields were ready for limited operations, and from these bases the first land-based mission against Japan was initiated at that time. Several months more of work were required to complete the whole project, with its all-weather hard-stands and taxiways, storage areas, technical buildings, and domestic housing.

Responsibility for the construction of U.S. airfields in India (except in a certain combat area) is vested in the Services of Supply. The Construction Services of the S.O.S. comprise several Engineer Divisions and Districts, and work closely with the British Engineers and their agencies. District Engineer in charge of the construction of the well-built Superfortress airfields was Col. Kenneth Madsen, C.E.

In the combat area referred to, airfields are built by British and Indian engineer troops, rather than by contract labor. Here the Air Forces' engineers work closely with the British, pooling their limited resources available to assist in this area. Thus an American soldier may operate a British bulldozer, working under a U.S. Superintendent of Construction, who himself reports to a British Garrison Engineer.

Pierced steel plank is used extensively by the British as well as by ourselves, and has maintained its reputation for usefulness under many conditions—though the lesson has to be constantly relearned that it is not a cure-all nor is it a substitute for a good base. The British have their own innovation known locally as "bit-hess" (an abbreviation of bitumen and hessian). This is composed of hessian cloth or burlap impregnated with asphalt and stocked in rolls for ease of application. The idea is to provide a rapid means of laying a waterproof material. This bit-hess is considered particularly useful in this monsoon country, where it is felt that many earth landing strips suitable for use during the dry season can be maintained in use during monsoons if the bearing power of the dry soil can be retained by means of this waterproof sheet. The bituminized cloth has, in itself, no appreciable bearing value, and accomplishes no more than could be accomplished by familiar techniques of applying asphalt. It does have the advantage of being a prepared material, suitable for quick laying with little plant. This promising new material has had a considerable measure of success in India, when used with appreciation of its capabilities and limitations. The experience of the aviation engineers in France, who have used bit-hess extensively for fighter fields, furnishes a still better criterion of its value—both as a waterproofing agent in wet weather and a dust palliative in dry weather.

PIERCED STEEL PLANK HAS UPHELD ITS REPUTATION IN INDIA

IN CARTS, WHEELBARROWS, AND BASKETS, THE CHINESE MOVED 2,000,000 CU YD OF ROCK TO THE JOB

THE HAND-BUILT AIRFIELDS OF CHINA

I have said that China is a land of peasants. It is also a land of engineers—if "utilizing the forces of nature to the service of man" constitutes being an engineer. Their skillful use in China of the land, and of water to irrigate the land, must receive admiration. After all, Tredgold says nothing about tools, nor does he say to what extent mass labor can be measured against modern machinery.

One distinguished Chinese engineer long before Tredgold—before Christ, in fact—once devised and built an irrigation system near one of our airfields to control the flow of water for that entire area. This system, with its weirs and regulating devices, is still in use—and no engineer of modern times seems to have been able to effect any material improvement in it.

For centuries the Chinese have made hard-surfaced roads. Rock is procured from streams or quarried by hand, carried to the job in baskets slung on shoulders, placed by hand in layers, compacted with improvised rollers. The traditional binder is a slurry of mud mixed by the roadside and poured into the voids. This mud-and-rock technique is substantially the one that has been employed on most Chinese runways. Such runways in the past have been constructed up to 24 in. in thickness. Built thus, they are strong enough to support our heaviest bombers, but the wearing surface is outstandingly deficient. This surface soon gets rough as rocks work up to the surface, and the wear on the tires is excessive.

The P-40's of Chennault's Flying Tigers used such existing airfields as they could find in Burma and China. Later, the newly constituted 14th Air Force, with its heavy and medium bombers, required more adequate fields, with longer and better runways. American engineers designed layouts for new fields and for the improvement of existing ones. Bomber fields were provided with dispersed hard-standings. For fighter fields, on the other hand, an alert apron adjacent to the runway

HAND-SET STONE ON A U.S. ARMY AIR FORCE BASE FOR SUPERFORTS IN CHINA

normally provided adequate parking space for the fighter planes, which were always capable of a quick take-off, and were served by an excellent Chinese warning net.

It is now well known that our B-29's in their recent strikes against Japan have operated from bases in India and from staging airfields in China. This group of fields had to be built in a hurry. The Chinese, when so minded, have a sense of urgency that is not everywhere prevalent in the Far East. No one is more gifted in this respect than Dr. Tseng Yung-Fu, their able Minister of Communications (to the Generalissimo, a sort of Director of Public Works). Dr. Tseng has under his direction a corps of engineers, of whom many have been educated in the United States. Dr. Tseng himself was educated at the University of Pittsburgh. His responsibility for roads, railroads, airfields, communications of all kinds in China is a broad one. He was engaged in the construction of the Yunnan-Burma Railroad from China to India in 1942, when the Japanese invasion of Burma halted this ambitious project. In this new emergency, Dr. Tseng went into action, with energy and enthusiasm.

At about this time, responsibility for the construction and maintenance of all U.S. airfields in China was assigned to the Army Air Forces and was delegated to Maj. Gen. Claire Chennault. Under his direction an organization of Aviation Engineers was quickly formed, working closely with the Chinese, and with the technical supervision and assistance of the Air Engineer, China-Burma-India. Such a task is the work of a team. But among the U.S. Engineers special credit for able direction should be given to Col. Henry A. Byroade, Engineer of the 14th Air Force and the China Air Service Area Command; and to Col. Waldo Kenerson, District Engineer in charge of constructing this group of airfields.

Many of the airfields in China are built by the contract system, but this was a special case, the urgency of which necessitated impressed labor. Last January more than a quarter of a million Chinese laborers left their farms, walked in some cases a hundred miles or more, built their hovels, went to work. The organization of such an army of laborers includes foremen, labor leaders (somewhat comparable to our union bosses), and cooks. They work industriously, cheerfully, for a wage that comprises two pounds of rice and 20 Chinese dollars a day—the equivalent of about 10 cents. Speed was the word—for the sake of the B-29's, and of these farmers as well, so that they could get back to their crops.

Specifications for this job were special—the old technique of rock and mud would not suffice. Could the habits of centuries be changed? They had to be changed. Sand could be brought from the river, as well as gravel—sand and clay to be mixed with crushed fines of rock (mostly done by hand hammering) to provide a smooth wearing surface. Another change was the substitution of the "loop" or "figure-eight" type of hard-stand for the old "frying-pan." Here was a task for American engineers, not only to design the fields and prepare specifications, but to ensure that these people who spoke another language understood and conformed.

The project called for several fighter fields, as well as for the larger bomber fields. At each airfield was a U.S. Resident Engineer with a mere handful of Americans to assist him. Considering differences of language, difficulties with the labor leaders, problems of payment, difficulties in enforcing the specifications, these resident engineers had a challenging task which they met outstandingly well. As one distinguished civil engineer wrote after several weeks of observation, "In some 25 years of engineering experience I have never yet seen a man or group of men go further beyond the call of duty than these engineers who were assigned the job of building airfields with practically nothing, and didn't know any better than to go out and do it!"

And so the work went ahead, and the airfields took shape. Rock from the river—2 million cu yd of it—moved to the job in baskets, wheelbarrows, carts, and a small number of charcoal-burning trucks. Much of this rock was placed in layers by hand. Sand and clay to a great extent took the place of the old mud-slurry as a binder. As for rolling, the pulling of a 10-ton roller by some 200 laborers in unison is quite a remarkable team performance.

The presence of 90,000 men on one airfield, swarming like ants, is something that has to be seen to be believed. Remarkable too is the organization that somehow effectively utilizes such vast numbers and which provides for feeding them and attending to their health.

AN UNUSUAL FEAT

On a January day I flew over a great field where many thousand laborers were just starting to level the bunds in the rice paddies. Just three months later to a day the first Superfortress landed on this spot, coming to rest on the long runway (over 8,000 ft) with hardly a mark. It is not surprising that the Chinese themselves compare this achievement with the building of their Great Wall.

The landing of the first B-29 did not mean that the project was finished—nor that the continuing problem of maintenance was solved. The maintenance of these gravel runways, lacking any good binding material, requires the constant labor of several thousand Chinese at each field. In dry weather dust is a serious problem, although some alleviation has been effected by the use of tung oil and other locally obtainable products. The most effective use of planes of this type requires the highest quality of runway, and greatly to be desired for surfacing was cement or asphalt (which it was entirely impracticable to bring in, at least initially, over the Hump).

A distinguished Chinese engineer told an equally distinguished American engineer that our method of constructing the Ledo Road, working from one end only, over the mountains, was too slow. His method would have been to distribute laborers, working with hand tools, all along the line. Perhaps he was right. Doubtless a combination of the two methods would produce the speediest results. In any event, we with our modern equipment must pay tribute to what can be accomplished by sheer mass labor without benefit of mechanical plant—but with the will to succeed.

Eight-Mile Tunnel for Apalachia Project

By GEORGE K. LEONARD, M. AM. SOC. C.E.

PROJECT MANAGER, HIWASSEE PROJECTS, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

AT a cost of 22 million dollars, the Apalachia Project has been constructed to augment the power supply in the Tennessee Valley. The dam and power house of this development are separated by 8 miles of tunnel and penstock. Complete records of progress and costs were kept and are given by Mr. Leonard in this paper. Actually it took only about 20 months to complete the dam, power house, and tunnel.

APALACHIA Project is one of four constructed by the Tennessee Valley Authority in the Hiwassee River watershed in western North Carolina and eastern Tennessee. The four projects, collectively, were known as the Hiwassee Projects. Construction by force account proceeded on all of them at the same time. Two of the four dams, Nottely and Chatuge, have no power plants but their useful storage doubles the available storage at Hiwassee Dam, 30 to 40 miles downstream from them. (See series of articles on TVA projects in CIVIL ENGINEERING, March through October 1943.)

The largest of the four projects is Apalachia, on the Hiwassee River 9.8 river miles downstream from Hiwassee Dam. Apalachia Dam is a gravity concrete structure, 150 ft high and 1,250 ft long. About 13 miles downstream is the power house with two 37,500-kw power units operating under a 440-ft maximum head, and connecting the dam and the power house is an 18-ft-diameter concrete-lined tunnel, 42,162 ft long, with an additional length of 1,778 ft of steel penstocks and liners.

Authorization for the project was given in an act signed by the President on July 17, 1941, and with power production promised for April 1, 1943, the construction force was given about 20 months to finish the dam, power house, and tunnel. It was known from the start that the tunnel schedule would be very difficult to meet. Actual excavation time was limited to 11 months (or about 3,840 ft per month), and the time for placing the concrete lining and steel liners to $9^1/_2$ months. The schedule was met with a combination of skillfully planned operations, expertly designed construction plant, modern equipment, and skilled personnel.

The tunnel line cuts off the bends in the Hiwassee River between the dam and power house and in so doing crosses a number of deeply eroded, tributary mountain stream beds. One of these, Turtletown Creek, was below the tunnel grade; the others were above grade but with thin cover. Near the power house the tunnel passes under a deep, dry canyon affording thin cover. The low mountains rising steeply from the river's edge provide deep, continuous cover except at these locations.

Arithmetic and topography determined the tactics. Since 155 ft of tunnel had to be excavated per day, and since an advance of 25 ft per heading per day was assumed, it was evident that at least 7 headings must be driven at the same time. Three open-adit cuts, called Apalachia, McFarland, and Smith Creek adits, were therefore driven into the tunnel line from the river side, along the canyons where the cover was thin, the floor of the adits being level with the tunnel invert. At Turtletown Creek, where the creek bed was about 30 ft below the invert grade, portals were opened on each side of the canyon. The three adits and the creek crossing each provided space for two portals. Counting the one where the intake penstock entered the mountain about 900 ft downstream from the dam, 9 portals in all were available. For a short time, excavation proceeded at all 9 headings, and after concreting started, all the portals were busy. While nature did not permit the adits to be equally spaced along the tunnel, it was later discovered that they were in strategic locations.

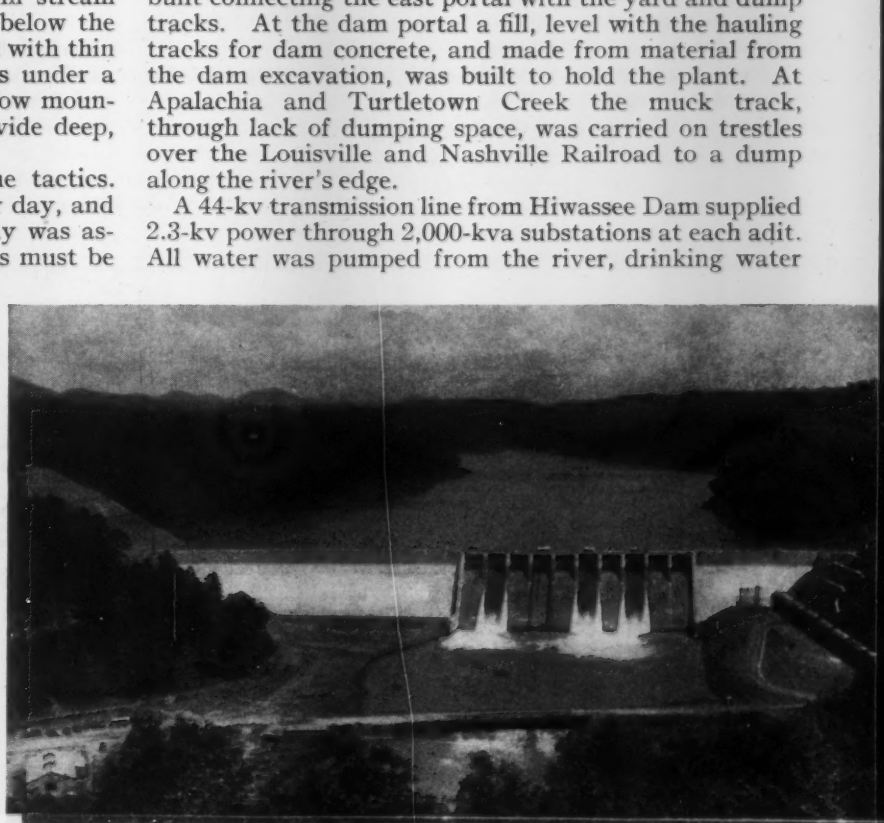
All adit sites were inaccessible to equipment when work started on July 18, 1941. The mountainous terrain was practically uninhabited and was covered with an extremely dense growth of timber and underbrush. Entering from the east end, only a narrow and unimproved U.S. Forest Service road penetrated the forest.

PORTALS OPENED

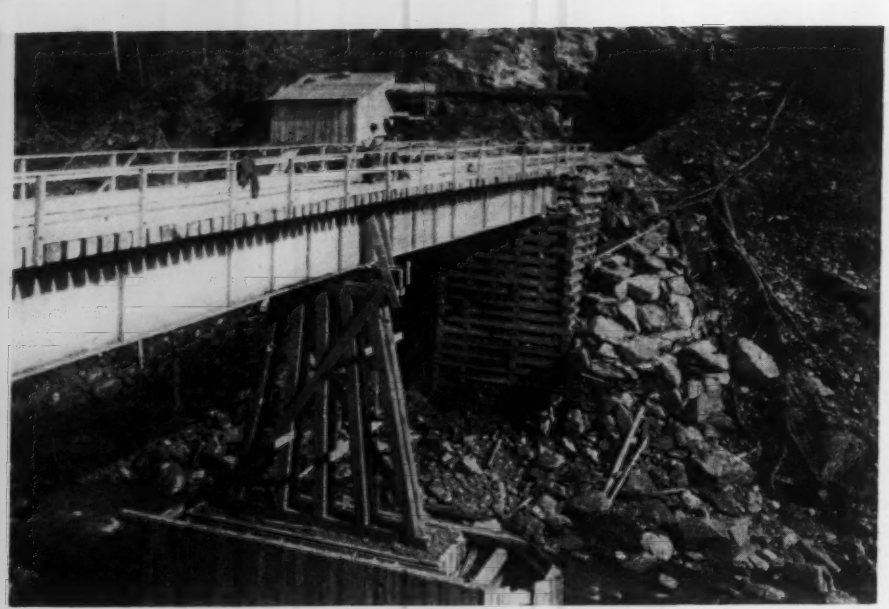
Another story could be written about the slow, dangerous, and costly road work—about the deep rock cuts, the high fills. This work was finished by the end of the year but in the meantime tunnel construction was proceeding at the McFarland adit. Here, by August 1941, shovels, compressors, and other equipment for excavating the adit cut were unloaded. The creek bed, all in rock, was deepened to invert grade and widened so that muck tracks could emerge on a sharp curve from each portal, and the creek, sometimes becoming a torrent, was diverted into culverts below the yard level. The spoil was dumped along the mountainside, thus forming enough yard space, although constricted, for setting up the excavating plant and starting the muck dump. Track laying and plant erection followed closely, and the first portal was opened on October 10, 1941.

As fast as access roads to the other sites became passable, similar adits were excavated at Apalachia and Smith Creek. At Turtletown Creek a different plan was followed. Both portals were faced off; a small initial yard area was cut out of the canyon wall adjacent to the west portal and downstream from it; and a bridge was built connecting the east portal with the yard and dump tracks. At the dam portal a fill, level with the hauling tracks for dam concrete, and made from material from the dam excavation, was built to hold the plant. At Apalachia and Turtletown Creek the muck track, through lack of dumping space, was carried on trestles over the Louisville and Nashville Railroad to a dump along the river's edge.

A 44-kv transmission line from Hiwassee Dam supplied 2.3-kv power through 2,000-kva substations at each adit. All water was pumped from the river, drinking water



APALACHIA DAM—PENSTOCK AT RIGHT LEADS TO DAM-SITE PORTAL OF TUNNEL



EAST PORTAL AT TURTLETOWN CREEK WAS REACHED BY AN ACCESS BRIDGE

being filtered and chlorinated by means of small portable plants.

Following the completion of the McFarland plant, practically identical plants at the dam site, Smith Creek, Apalachia, and Turtletown Creek followed in succession. They included a change house with lockers, showers, toilets, and clothes-drying facilities for the tunnel crews; a compressor building with an installed capacity of 4,000 to 5,000 cu ft per min; a blower plant with a capacity of 40,000 cu ft per min; a battery shop for repairing, charging, and changing the 56-cell, 112-v storage batteries used in the 50-hp tunnel locomotives; a dressing and sharpening shop for drill-steel and detachable bits (at three adits only); warehouse; pipe and electric shops; and a small office building housing the engineers, first aid, safety inspector, timekeepers, and foremen. Heavy machine-shop equipment of all kinds was available at the dam site. A 36-in.-gage track system was provided to connect the plant buildings with the portals and muck dump.

The heavy batteries were handled with a 5-ton electric trolley hoist running on a monorail over the charging floor and yard track. There were three or more batteries for each locomotive and they were changed every eight-hour shift.

Each heading was serviced with the following systems hung along the tunnel wall:

Ventilating air—30-in. spiral welded pipe
Compressed air—6-in. spiral welded pipe
Untreated water—4-in. spiral welded pipe
Treated water—$^3/_4$-in. galvanized pipe
Electric power—2,300-v, 3-conductor, armored cable

The high silica content of the tunnel muck and a rule-of-thumb demand for about 2,000 cu ft per min for each drill on the jumbo required a blower capacity of at least 20,000 cu ft per min for each heading. The direction of air flow was reversible, and the large capacity saved much time in cleaning the heading of blasting fumes.

An extensive organization directed by the tunnel superintendent was required to meet the fast tunnel excavation schedule. Work at the headings was continuous on six days a week, and Sunday was spent overhauling equipment, surfacing track, and getting everything ready for another week's drive. Because of the narrow, dangerous roads and lack of parking space, no privately owned cars were permitted in the area, and the workmen were taken to the adits in busses.

Enough equipment was purchased to complete a full drilling and mucking cycle each shift at each heading. The 8-hour cycle was divided into (1) drilling and loading a full-face, 11-ft round, 2 hours 30 min; (2) firing, ventilating, examining for misfires, 30 min; and (3) mucking, scaling roof, extending tracks and pipes, 5 hours. A full heading crew with hourly pay rates included:

1 shift foreman (shifter)	$1.40	2 motormen (rated as miners)	1.25
11 drillers (miners)	1.25	1 mucking machine operator	1.50
11 drill helpers (chuck-tenders)	1.00		
3 steel nippers (rated as helpers)	$1.00		

In addition there were for each shift, at each adit, 18 laborers, 2 mechanics, and the necessary operating personnel in the drill, welding, blacksmith, and electric shops and warehouse, change and battery houses, and compressor and blower buildings.

Full-face, 20-ft-diameter headings were wet-drilled with 11 drifter-type drills with automatic rotation and pneumatic feed, mounted with universal column clamps on the arms at the forward end of a drill carriage or jumbo 30 ft long. The latter were designed and built on the job, of extra heavy 4 and 6-in. pipe mounted on 20-ft flat cars, with a 10-ft forward counterbalanced overhang. Drilling was done from track level under the overhang and from four folding steel platforms at two levels above the rails. When the wings were extended, the jumbo was 17$^1/_2$ ft wide, when dropped, 7 ft wide, so that it could be sidetracked for the passage of muck trains. Air and water manifolds and flood-light circuits were mounted on the chassis with fast operating couplings for connection to the service lines along the tunnel wall.

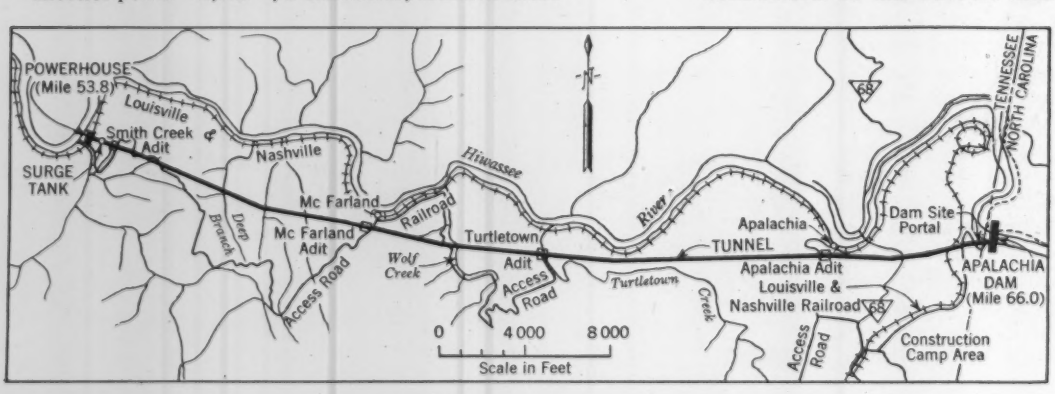


FIG. 1. PLAN OF APALACHIA PROJECT

The heavy 30-in.-diameter, 30-ft sections of ventilating pipe, which were kept about 100 ft behind the heading, were put in place with a time-saving davit-like crane with a hand winch mounted on a flat car.

Drill steel, bits, repairs, and supplies were carried on a flat car behind the jumbo. Steel for a full round went up to the heading every

Leads to Dam-Site Portal of Tunnel

Plant at Smith Creek Adit, Confined in a Narrow Valley

shift. Starters were 3 ft long with bits 2 in. in diameter, and with 5 changes 2 ft in length. The holes were bottomed with 13-ft steel and $1^{11}/_{16}$-in. bits. Although accurate gaging and careful heat treatment were necessary when the bits were resharpened, it was found that $^{1}/_{16}$-in. changes increased the drilling speed and allowed lower-priced bit sizes to be used.

A full face, 11-ft round required 56 to 65 holes. The vertical wedge-cut was used in the hard quartzite in the east half of the tunnel, while the pyramid-cut was used in the slate in the west half. The inclined cut-holes were 13 ft long. They were blasted first to provide a free face toward which the straight "relief" and "lifter" holes would break. Two holes outside the circle provided overbreak for the curb. The work was highly systematized, all operations being delegated to some crew member and timed and synchronized to eliminate all lost time. Crews worked under high pressure while drilling and loading.

The equipment and methods used in the 20-ft-diameter heading served equally well without changes in a 6,000-ft long section where the concrete lining was omitted and a 22-ft-diameter heading was drilled.

A special car carried the dynamite and detonators to the heading in separate compartments. Holes were loaded by the drill crews with 40% gelatin dynamite, using 600 to 700 lb per round, at the rate of about 5 lb per cu yd. Eight delays were used; the "cut" shots were fired first, followed by the "relief," "lifter," and "square-up" shots in that order. Overbreak varied with the "blockiness" of the rock, and was caused by joints, bedding planes, and schistosity, but for the entire tunnel it was almost exactly 12 in.

Table I. Progress per Day in Tunnel Clean-Up, Lin Ft

Item	Maximum	Minimum	Average
Clean-up for curb	660	480	610
Trimming arch	590	490	560
Clean-up for invert	410	300	350

Before loading started, all electrical circuits at the heading were opened and light was supplied from flood-lights mounted on the battery locomotives. Lead wires and detonators were kept short-circuited until connected to the blasting circuit. The powder man left the heading last with the key to the firing switch, which was about 1,500 ft from the heading. No blasting accident occurred in firing over 4,500 rounds and thousands of smaller trimming shots.

Conway loaders put the muck into the 6-cu yd side-dump cars. Muck was distributed from the front to the back end of the car by changing the position of the coupling pin in the adjustable drawbar between the loader and the car. Rapid work with the car passer saved loading time. The loaded car was pulled back beyond the passer and an empty car was moved from the passer onto the track ahead of the train, which pushed it forward into loading position. While it was being loaded, another empty car was put on the passer and the train was coupled to the loading car ready for a quick pull away from the loader. About 135 cu yd of solid rock, requiring 10 or 11 five-car trains, was handled in each round. The heavy blasting, which broke the rock down to easy mucking size, saved additional time, so that the entire mucking operation was done in about 5 hours.

Water inflow and drainage were of a minor nature, and little pumping was necessary. Grouting, to cut off inflow, was resorted to in several locations before drilling could proceed. At two creek crossings, Wolf Creek and Deep Branch, the shallow cover was consolidated by grouting in advance of driving, and this without doubt eliminated potential heavy leakage into the tunnel.

The weathered rock near the portals required timbering for short distances, but only about 800 lin ft was necessary in the entire length. Five-segment sets made of 10 by 10-in. timbers were used in lieu of steel supports, which did not arrive in time. Steel supports were, however, installed under Deep Branch.

Around the portals, the surface of the rock was coated to prevent the raveling of shattered and weathered faces. This coating, about 1 in. thick, held the faces satisfactorily and was in fair condition two years after placing.

After the tunnel was excavated, a major operation remained to prepare it for the concrete lining. The rock projecting inside the neat line, or "tights," was blasted off; the tunnel wall was washed; and the muck on the invert, most of which was track ballast, was removed. This work involved small yardages and much hand work, and even with well-designed, special equipment, the cost always seemed too high. It had to be planned carefully. As soon as a section had been holed through and the ventilation pipe removed, sufficient width along both sides of the muck track was cleaned and the curbs were poured. Part of the muck was removed by the loader but it was chiefly a hand clean-up job. "Tights" were drilled with jackhammers and shot with light charges.

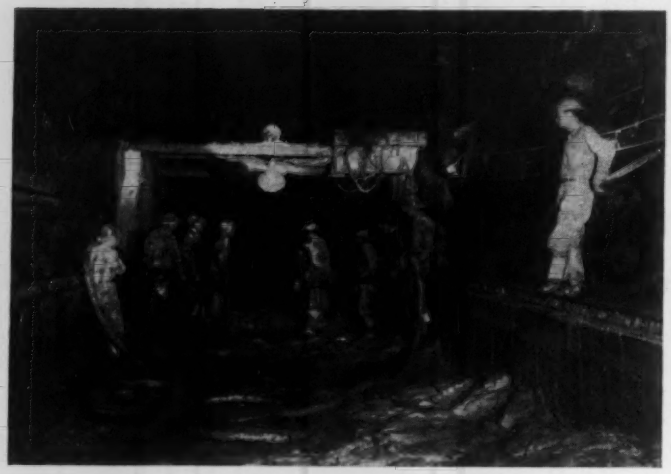
Tight spots in the arch were found with a traveling template mounted on flanged wheels traveling on the corners of the curbs. The circular wood frame, 18 in. smaller in radius than the neat section, held spring feelers 18 in. long. These were made from old band saws, and radiated from the frame to the neat line. "Tights" contacted by these feelers were painted for removal by the trimming crew which followed.

The trimming jumbo, also traveling on the curb, was made of 4-in. pipe and carried five drifter drills, two

Table II. Plant Costs for Tunnel Excavation

Item	Production, Cu Yd	First Cost	Salvage	Net Cost	Net per Cu Yd	Cost per Ft Tunnel
Track material	857,047*	$125,600	$37,000	$88,600	$0.103	$1.51
Track work	657,401†	67,900	....	67,900	0.103	1.51
Trestles	622,074‡	41,500	1,700	39,800	0.064	0.94
8 drill jumbos	622,074	41,400	6,400	35,000	0.056	0.82
126 drills	657,401	70,044	35,244	34,800	0.053	0.78
Sharpening equipment	657,401	19,662	13,062	6,600	0.010	0.14
104 muck cars	657,401	33,111	15,111	18,000	0.027	0.40
61 flat cars	657,401	7,886	4,686	3,200	0.005	0.07
			Total		$0.421	$6.17

* Includes 199,646 cu yd concrete hauled over the track.
† Includes 35,327-cu yd surge shaft excavation.
‡ Tunnel excavation only.



INVERT WAS CLEANED WITH AIR JETS USING A SHIELD

mounted on adjustable, horizontal arms on each side, and one mounted on an arm adjustable across the top member of the frame. Blast holes were drilled and loaded in the painted areas. Both template and trim jumbo permitted the passage of muck or concrete trains beneath them.

Following the trimming, cleaning of the invert was started. The muck track rail was removed from the ties and set on the curb. As each section of track was dismantled, an electric-powered tractor with bulldozer attachment pushed the spoil toward a belt loader operating on the next section of track. The rails were then connected on the curb and gaged to carry the clean-up shield and later to serve as a track for the invert concreting bridge.

TABLE III. FIRST COST OF TUNNEL COMMON PLANT

ITEM		FIRST COST
Preparation of adit sites:		
Clearing and grubbing	$ 8,782	
Excavation and fill (90,000 cu yd)	148,629	
Temporary roads (does not include main trunk roads)	60,615	$ 218,026
Compressed-air system:		
Erection—buildings, machinery and distribution system, 75,600 lin ft	96,000	
Material—distribution system, 45,000 lin ft	54,440	
Machinery—12 compressors, 7 receivers	160,000	310,440
Ventilation system:		
Erection—buildings, machinery	38,162	
Material—distribution system, 45,000 lin ft	86,380	
Machinery—4–11,140-cfm, 10–7,500-cfm blowers	50,959	175,501
Water system:		
Erection—buildings, machinery, distribution	50,000	
Material—distribution system, 121,664 lin ft	43,636	
Machinery—pumps, purifiers, coolers	19,905	113,541
Electrical system (not including 44-kv transmission line):		
Substation erection only	8,150	
Switchboards	28,300	
Distribution system: Erection	37,662	
Wire and cable	39,567	
Equipment	5,877	119,556
Miscellaneous buildings:*		
All except air, ventilation and pump buildings	106,427	
Equipment—fans, boilers, heaters, tanks	4,964	111,391
Locomotive batteries and boxes		89,330
Unloading and storing equipment		15,157
Miscellaneous major equipment:		
Motors, battery chargers, hoists, cement guns, grout pumps, etc.		27,233
Total cost of common plant		$1,180,175

* Most of this cost was in change houses and battery houses.

The sheet-metal shield was 6 ft high and 30 ft long. Muck which the bulldozer could not move from the rough invert was loosened and blown toward the forward end with air jets without interfering with the other clean-up operations and without spattering the arch walls, previously washed. The residue was loaded by hand into a skip pan riding the rails ahead of the shield, and moved to the loader a short distance ahead. After the invert had been checked for "tights," the tunnel was ready for the placing of the concrete lining. Progress attained in tunnel clean-up is shown in Table I.

The following progress record is indicative of the skill and esprit de corps of the tunnel crews:

Max. advance per heading:	day, 53 ft; week, 248 ft; month, 1,007 ft
Max. advance 7 headings:	day, 269 ft; week, 1,491 ft; month, 6,132 ft
Average daily advance:	entire job, 27.7 ft; best heading, 30.4 ft
Max. month, excavation:	7 headings, 73,600 cu yd; best heading, 14,700 cu yd

During the month of maximum advance the following production data were recorded:

Total heading advance	6,132 lin ft
Solid rock, per lin ft of tunnel	12 cu yd
Dynamite, per cu yd	5.1 lb
Exploders, per cu yd	0.56 each
Holes drilled, per cu yd	5.9 lin ft
Average depth of holes	11.1 lin ft
Length of tunnel fired per round	9.4 lin ft
Advance per heading per shift	11.3 lin ft
Drilling per round	780 lin ft
Drilling per actual drilling hour	444 lin ft
Rock mucked per heading per shift	135 cu yd
Rock mucked per actual mucking hour	32 cu yd
Solid rock per car	2.6 cu yd

Excavation plant included the items in Table II, the initial cost of which, less salvage, was spread over the production yardages. The first cost of the common plant for the tunnel is given in Table III, and a detailed cost analysis appears in Table IV.

TABLE IV. DETAILED UNIT COST ANALYSIS OF TUNNEL EXCAVATION

General Expense Not Included; Depreciation Estimated, Since All Plant Has Not Been Sold

ITEM	COST PER LIN FT	ITEM	COST PER LIN FT
Ventilation	$ 1.47	Temporary supports	$ 3.25
Drainage and pumping	1.00	Depreciation of common plant	17.32
Grouting, 3,882 cu ft	0.62	Total for tunnel excavation	$86.62
Total	$ 3.09	Trim and clean-up:	
Excavation:		Drainage and pumping	1.25
Drilling	19.89	Trimming	1.29
Blasting	10.16	Clean-up	8.00
Mucking	16.55	Depreciation of common plant	2.63
Hauling and spoiling	10.16	Total	13.17
Depreciation, excavation equipment	6.17	Grand total:	
Total	$62.93	Based on 42,424 lin ft	$99.79
		Based on 622,074 cu yd.	6.81

Construction of the Apalachia Project was inaugurated while the late Theodore B. Parker, M. Am. Soc. C.E., was Chief Engineer of the TVA. He was succeeded on July 1, 1943, by C. E. Blee, M. Am. Soc. C.E. A. L. Pauls, M. Am. Soc. C.E., was Chief Construction Engineer. At the job, Charles P. Wright, M. Am. Soc. C.E., was Construction Engineer; T. L. Brown was Construction Superintendent, succeeded on June 1, 1942, by R. V. Sass; and George W. Foster was Tunnel Superintendent, succeeded on May 1, 1942, by D. F. Simpson. Tunnel excavation was largely completed by Messrs. Brown and Foster.

Engineers' Odyssey to Europe—1889

Record of Notable Trip Emphasizes International Comity and Hospitality

Part I. New York to Liverpool

IN 1889 the American Society of Civil Engineers, in association with the American Society of Mechanical Engineers and the American Institute of Mining Engineers, organized a group to visit European countries and the Paris Exposition. Some fifty members of the American Society of Civil Engineers were included in the party which, with ladies and other guests, numbered about three hundred. Warm greetings and elaborate programs of entertainment were accorded by the engineering societies, municipalities, industries, and private citizens in the several countries visited.

The four living members of the Society who took part in the event have recently assembled such information relating to its history as memory and data in their possession could supply. All four must have been among the youngest of the entire group. They have now attained an average age of approximately eighty years. Consequently, it is not strange that, of the Society's whole delegation, they should have become sole survivors.

Folwell and Provost, already friends, planned their trip together. They were inseparable for the entire twelve weeks. French and Thomson also were friends, coming from the same design office. These friendships have persisted through the years.

These recollections, written separately, were intended primarily to complete the Society's records of this historic trip. But they also hold a fascination for engineers of today, almost six decades later. Hence a series of articles have been prepared based on the four accounts, assembled by the editors.

In this, the first instalment, the reader learns something of the trip on the S.S. "New York" and the entertainment at Liverpool. Additional articles of the series are in preparation. Since the accounts are primarily personal in nature, the excerpts here given have been arranged in dialogue form.

Dramatis Personae

A. PRESCOTT FOLWELL.—Recently graduated, he had been serving as assistant to John Bogart, Secretary of the Society.

JAMES B. FRENCH.—After a few years of other experience, he was at the time draftsman and designer with Pencoyd Bridge Co.

ANDREW J. PROVOST, JR.—Almost a graduate, his final exams were advanced to permit this trip. He promoted the present history.

T. KENNARD THOMSON.—Recently married, he resigned a good position with the Pencoyd Bridge Company to take the trip with his bride and his sisters—and never regretted it.

FRENCH: One of the first privileges which I exercised after becoming a Junior of the Society in February 1889 was to join the group of members engaging passage on the steamer *City of New York* sailing May 29, 1889, as the beginning of this European trip.

PROVOST: The project was initiated by invitations to the several national engineering societies in the United States from the Institution of Civil Engineers in London, offering hospitality and entertainment in England during the summer of 1889 in the event of a group party's being organized. Following the acceptance of these invitations, a sufficient interest was shown in the project to justify chartering the S.S. *City of Richmond* of the Inman Line. This ship had accommodations for 170 first-class passengers, and was eventually assigned to transport the combined groups aggregating that number formed by the American Society of Mechanical Engineers and the American Institute of Mining Engineers.

FRENCH: Exclusive of relatives and guests, the "Final List" of those booked for this trip contained some fifty Society members, and it is a significant reflection on the ravages of time to say that to the best of my present knowledge Messrs. T. Kennard Thomson, Andrew J. Provost, Jr., and A. Prescott Folwell are the only ones, other than myself, who are still living.

PROVOST: Shortly before the scheduled departures, letters were received by all members of the joint party from James Forrest, Secretary of the Institution of Civil Engineers, containing an invitation to attend a dinner to be given Thursday, June 13, in the Guildhall of the City of London, placed at the disposal of the Institution by express sanction of the Right Honorable Lord Mayor, Aldermen and Council, for the purpose of entertaining the members of the different American engineering societies. The invitations prescribed formal dress. This word of caution caused some of us to find space in our baggage for articles we had thought might be left out.

As a registered guest of the Society of Mechanical Engineers, a stateroom had been assigned me on the *City of Richmond*. One of my classmates was booked for the *City of New York*. We both were anxious to change ships. Dr. Charles E. Emery, member of the Society, was chairman of the arrangements for personnel. A call on him at the Society Headquarters, then at 127 East 23d Street, quickly arranged the desired transfers. So, by paying my friend fifteen dollars, the difference in round trip fares, we became, so far as sailing lists were concerned, transposed personalities. I made both crossings under the name of Arthur Mahoney, and he did the same under my name. Not the slightest inconvenience resulted to either on account of these disguises.

We sailed from New York late in the afternoon of Wednesday, May 29. Besides our group, the ship carried many tourists, and was booked to full capacity. It would be a strange sight in these days to see a flock of passengers ascend the gangplank of a ship burdened with deck chairs and rugs. Such was then the custom. These appurtenances were checked at the port of debarkation to await the return voyage.

Folwell and I shared a stateroom, and were destined not to be separated a day until our return late in August. Seated, then, in our chairs in a comfortable spot when the ship cast off, we watched the familiar landmarks drop behind, and reflected no doubt on the strange adventures that might be ahead of us. Curiously, enough, one was in the making at the moment, as unexpected as it was unusual. Before we reached the Narrows, dinner was announced. The decks were soon emptied of passengers, but we tarried to catch final views of the city. When at last we went down to dinner,

LIVERPOOL TOWN HALL, SCENE OF ELABORATE CONVERSAZIONE

others were occupying our seats. They held identical coupons, and there were no other unassigned seats.

In this awkward situation, an invitation was conveyed from a gentleman occupying an alcove with several others, to join his party. Upon our grateful acceptance, our host was introduced as the Earl of Chesterfield. He gave us a most cordial welcome. The Earl, a tall, handsome man of perhaps thirty-five, had been traveling in the United States and Mexico with a party that included a college chum, his physician, a retired naval officer, and other friends. He had his own supplies of wines, fruit, flowers, and cigars, as well as table servants, and did everything to make us feel adopted into his party. Before the end of the voyage, he was kind enough to suggest he would like to have us up at his lodge in Scotland for the fall grouse shooting.

FRENCH: It seems worthy of note that the steamer, *City of New York*, and her sister ship, the *City of Paris*, of the old "Inman Line" were then considered the finest passenger steamships plying between Liverpool and New York and we were being carried by the *City of New York* —as I recall on the last half of her maiden voyage. She was indeed a beautifully appointed ship and I wrote home an enthusiastic description of the library as "a large room elegantly fitted up in richly carved oak panels bearing the names of English and American authors."

PROVOST: Going on deck after the first meal, we found that the ship was off Sandy Hook. Near by lay a sleek, lazy liner poised as if waiting for us. Soon she gathered speed, and the two ships headed for Europe. This proved to be the *Teutonic*, recently launched by the White Star Line to contest the speed supremacy held by the Inman Lines' sister ships, *City of Paris* and *City of New York*, at the time unsurpassed in size, speed and luxury of fittings, and whose twin screws were a novelty in ship propulsion.

The following four days gave us fine weather and calm seas. The two ships were constantly in sight of each other. On the fourth night, the weather changed to a gale with heavy sea. Thereafter, we had no view of the *Teutonic*. The last part of the voyage was made in fine weather. This did much to revive the spirits of the many who had been indisposed during the gale.

FRENCH: We arrived opposite Queenstown Harbor about 4 p.m., Wednesday, June 5, and there a boat came out to take off the mail and some 150 of the passengers from our ship. Incidentally it brought out copies of the London edition of the *New York Herald* giving details of the terrible disaster at Johnstown, Pa., which had happened on May 31 while we were at sea. This bad news affected some of our passengers from Western Pennsylvania so seriously that they were obliged to cancel all their plans and return home as quickly as possible.

THOMSON: The evening before reaching Liverpool I managed to get the four ladies of my party up on deck for fresh air; they could not walk alone, they were so weak. But hardly had I got them all comfortably seated in their steamer chairs (we had ours until very recently), when a wave swept up and soaked them all. So I had to take them all down below decks again.

ARRIVAL AT LIVERPOOL

FRENCH: When we came on deck on the morning following, the buildings of Liverpool and of Birkenhead on opposite sides of the Mersey River were coming into sight, and a few hours later the steamer came to a stop opposite Prince's Dock and its great landing stage, to which we were transferred by means of a small tug or steamer called a tender.

The landing stages on the Mersey were structures well worthy of notice. Floating at a constant height above the water level, and connected to the shore by long-hinged bridges, they provided convenient platforms for rapidly embarking or landing passengers at all states of the tide notwithstanding its great range of rise and fall. This range in the Mersey exceeds 30 ft at times, while in New York Harbor the daily range is less than 6 ft, though the difference between extreme high and extreme low tides is about 11 ft.

The great landing stage at Liverpool lay opposite the center of the city, had a continuous deck 2,063 ft in length and of a general width of 80 ft. It was connected to the shore by seven bridges, and by a floating roadway

ENTERTAINMENT FOR LUNCH—GUESTS OF MR. AND MRS. WILLIAM LAIRD, BIRKENHEAD

550 ft in length and 35 ft wide, providing an easy incline for wheeled traffic at all stages of the tide.

From the landing stage we were taken over one of the hinged bridges into the large examining rooms of the customs officials. There, to the surprise of some of us, our luggage had to be carefully examined; for though we had thought of England as a "Free Trade" country we found that she still had a duty on cigars, tobacco, spirits, and a few other articles, and seized as contraband any books copyrighted in England but reprinted in America.

PROVOST: Our first trip of inspection was to the docks, under the escort of officers of the Dock Estates. The docks, we were informed, lined the east shore of the Mersey River for a distance of six miles, and there were many more on the west, or Birkenhead, shore. At Liverpool, the docks fringed the city itself, being separated from it by a narrow strip occupied by railroad tracks for the transportation of merchandise. Because of the great tidal range, the docks were constructed as basins, each controlled by gates so that full-tide or part-tide levels could be maintained to permit convenient wharfage throughout all tidal stages. Many of these basins had patriotic names, such as King, Queen, Albert, Clarence, Nelson, Wellington, Trafalgar, and Waterloo. We were able to visit only a few.

FOLWELL: Having been employed as engineer on the reconstruction of locks of the Erie Canal just before the trip, I was especially interested in these locks and docks. I was impressed by the fact that all the walls, even the copings, were constructed of hard-burned brick, whereas on the Erie Canal all locks were of heavy stone masonry. The brick copings near the snubbing posts seemed to be worn less by the rubbing of the snubbing ropes than were the stone copings of the Erie locks.

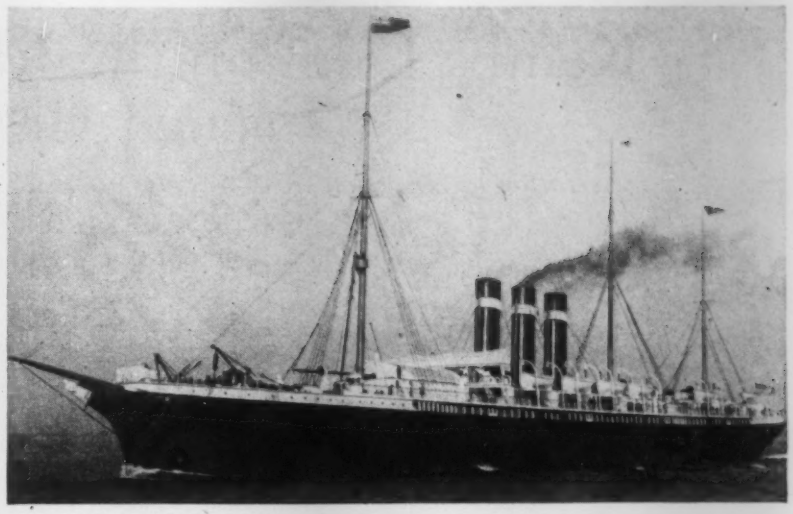
The street paving leading to the Liverpool docks was of rough stone blocks, giving a very uneven surface, possibly to afford foothold for the draft horses, which were heavier than those seen around New York's docks.

PROVOST: It was noted that many of the ships we passed were dressed as for review as a gesture of courtesy to the American engineers.

FRENCH: The Laird Brothers' establishment, which we visited in Birkenhead, across the Mersey River, had been in existence since 1824 and at the time of our visit had constructed some 576 vessels of an aggregate tonnage of over 350,000 tons. These had been built largely for the British Government, but included many for foreign customers, among which was the *John Randolph*, reported to have been "the first iron steamer ever seen in American waters."

This highly interesting inspection completed, the party was taken in open conveyances through Birkenhead Park and past the most notable public buildings to the Town Hall and thence to the spacious residence of Mr. and Mrs. William Laird, where the whole large party was invited to luncheon. To many of us the ride through the extensive Birkenhead Park, and the adjacent residential section, afforded our first taste of the beauty of English country scenes in early June. The hawthorne was in bloom and the yards were filled with flowers and foliage.

PROVOST: Return to Liverpool was made by means of the quite recently constructed Mersey Railroad Tunnel, joining Liverpool and Birkenhead, and about one and a quarter miles in length. This was in all probability one of the earliest subaqueous tunnels constructed for steam railway traffic. Upon alighting from the train, the entire group of at least a hundred persons entered an elevator cage and was lifted one hundred feet to the surface by hydraulic power. Few if any of the party had ever before seen so large a cage, but admiration for the supremacy of English engineers in such matters was soon followed by patriotic pride on the discovery of a plate which announced that the installation was made by the Otis Elevator Company of New York.



Courtesy United States Lines

SS "CITY OF NEW YORK," GREYHOUND OF THE EIGHTIES

CONVERSAZIONE OF IMPRESSIVE FORMALITY

The social function held for the joint party at Liverpool was a reception, or conversazione, given on the evening of that day at the beautiful Town Hall by the Mayor, E. H. Cookson, Esq. Opportunity was offered to meet the deputation from the Institution of Civil Engineers that came from London to greet our party, as well as the many prominent citizens who were in attendance. The entertainment included music, dancing, and a collation. Until this event, my growing impressions of the English people had been that, barring pronunciation and the use of a few curious words and expressions, they were much like us at home, and presumably that they played their games and danced with the same technique as we. However, when Mr. Daglish, indefatigable member of the reception committee, presented me as a dance partner to Miss Cookson, daughter of the Mayor, we might as well have been taught the waltz on different planets so far as harmony of motion was concerned. Promptly we decided to chat instead, and Miss Cookson entertained me delightfully until claimed by an English youth.

FRENCH: This reception, and the conversazione following it, were carried out with impressive formality and friendliness. In common with the excursions earlier in the day, it was treated as a notable international occasion.

PROVOST: The English observe a church holiday, Whitsuntide, that begins the seventh Sunday after Easter and extends over several days. That year, Whitsunday fell on June 9. So we were to be on our own until Thursday, June 13, the day set for our reception in London. Accordingly the party broke up into groups of various sizes, some going to North Wales, some to the Lake Country, others elsewhere as fancy dictated.

On Wednesday, June 12, the various trips converged on London. Here, the following day, began an elaborate succession of meetings, inspection trips, and receptions, to be described in some detail in the next article of this series.

Kembs Dam on the Rhine, Again in French Hands

Description of Diversion Structure, Power House, Canal, and Locks Completed in 1932 and Bombed in 1944

By JOSEPH D. LEWIN, M. AM. SOC. C.E.
CONSULTING ENGINEER, NEW YORK, N.Y.

WAR news constantly reminds civil engineers that the beneficial projects which they have constructed are very likely to become military objectives when war sets loose the powers of destruction. Victories are measured by the skill with which an army can destroy such an objective while it is in enemy hands and quickly rebuild it when the site changes hands. A case in point is the Kembs Power and Navigation Project on the Rhine River, which was bombed by Allied planes in October and which has been retaken recently by French forces. As described by Mr. Lewin, who was engaged on the construction of the dam, this project has several unusual features which will complicate a speedy reconstruction if that is at all feasible.

AS early as 1837 the French nation began to plan the Alsatian Canal—a navigation and power project paralleling the Rhine River as it swings north from Basel, Switzerland. For nearly a century the French endeavored to obtain rights for the project from the Germans and finally succeeded through a provision of the Versailles Treaty. The first part, a 3.4-mile stretch—the Kembs (Fig. 1)—was placed in operation on October 9, 1932. Twelve years later, on October 7, 1944, it was destroyed by an aerial attack.

Kembs lies on the French bank of the Rhine River, only four miles downstream from Basel, where the French, German, and Swiss borders meet. The Rhine River between Lake Constance and the city of Mannheim is quite rapid. Since the river passes through Lake Constance, its outflow is regulated by the great surface area of this lake, which is half as large as Lake Champlain. This regulating effect can be seen from the following comparison with the Tennessee River, in terms of cubic feet per second:

	RHINE AT BASEL	TENNESSEE AT FLORENCE, ALA.
Minimum flow	14,100	4,070
Six months' flow	39,000	52,300
Maximum flood	212,000	470,000

In order to extend navigation on the Rhine into Lake Constance, Germany in agreement with Switzerland built several low dams similar to those of our TVA projects. Each consists of a power house, movable gates, and a lock 443 ft long, 39 ft wide, and 10 ft deep at the sill. All these plants are runoff power installations without any storage to speak of, since Lake Constance acts as a regulating reservoir. To utilize the excess night energy, Germany built the Schluchsee pump storage project, ultimately consisting of three consecutive stages, having a total head of 2,030 ft, a 183,000-kw generating capacity, and a pumping capacity of 635 cu ft per sec. A double 220-kv transmission line connects all the plants of the Upper Rhine and the Schluchsee with the industrial Ruhr Valley.

The Rhine up to Basel was navigated until 1932 without any regulation. Because of ice, low water, and the perilous rapids of Istein, just six miles below Basel, navigation was interrupted for 100 to 150 days yearly. The rest of the year tugboats with barges went up to Basel. River traffic at Basel in 1930 totaled 1,700,000 tons. At Strasbourg another 6,000,000 tons were handled.

To improve navigation conditions between Basel and Strasbourg, Germany proposed to regulate the Rhine with several dams, similar in type to those on the Upper Rhine. France proposed to canalize this part by building a lateral canal on the left or French bank of the Rhine, with only one diversion dam across the river, but with a series of eight locks and power houses (Table I).

This project, originally submitted in 1837 by Emile Koechlin to the French Academy of Sciences, was bitterly opposed by Germany, and not until 1919 did it become feasible through stipulations in the Versailles Treaty, Article 358. In compliance with this Article, France submitted the plans of the Alsatian Canal to the Rhine River Commission. The project consisted of a diversion dam, the key structure for the lateral canal, and eight power plants and locks.

DESCRIPTION OF DAM

This Kembs Dam was 590 ft long, and consisted of five gates 100 ft wide, piers 16 ft wide, and a fish ladder and fish elevator (for salmon) on the left bank between the

FIG. 1. KEMBS POWER PROJECT, LOCATED ON THE ALSATIAN CANAL PARALLELING THE RHINE RIVER

dam and the canal. The dam raised the water level 26 ft normally and 29.5 ft at low water. To limit inundated areas, dikes along the Rhine were proposed. At the dam site the lateral dikes were 33 ft high, and 820 ft wide at the base on the German bank and 1,310 ft on the French bank. The gates were of Stoney type, double-leaf, electrically operated, with a height of 39.5 ft, the upper leaf being 15 ft high. The piers were founded on compressed-air steel caissons, 108 ft long, 22 ft wide, and weighing about 100 tons. The spillway section had a reinforced concrete apron with an upstream cut-off wall reaching 33 ft deep into the clay foundation, and a down-stream cut-off wall 46 ft deep. The entire concrete structure was protected by granite facing.

VIEW OF KEMBS PROJECT FROM DOWNSTREAM, WITH RHINE RIVER AT EXTREME LEFT

The lateral intake for the canal was about 1,600 ft upstream from the diversion dam. The navigation-power canal, trapezoidal in shape, with side slopes of 1:3, was designed for a flow of 30,000 cu ft per sec and a velocity of 2.3 ft per sec. (The normal velocity of the Rhine is 6.5 to 10 ft per sec.) The comparative size of this canal can be visualized from the following data:

	WIDTH AT BASE, FT	WIDTH AT SURFACE, FT	MINIMUM DEPTH, FT
Kembs Canal	260	500	39.5
Suez Canal	197	394	36.0
Culebra Cut of Panama Canal	315	350	45.0

The canal was planned to extend ultimately from Basel to Strasbourg, a distance of 96 miles. Eventually, the 220 miles from Basel to Mannheim would be cut to 171 miles, a shortening of 22%. The first development was 3.4 miles long, and consisted of a power house and locks, and a tailrace 3,600 ft long (Figs. 1 and 2).

This development bypassed the greatest difficulty to navigation on the Rhine—the rapids of Istein with a velocity of 49 ft per sec. Navigation was served by two locks, rectangular concrete structures 82 ft wide, with a 55-ft maximum lift. The large lock was 600 ft long, the small one 328 ft long. The lock gates, of balanced lift type, were electrically operated. The upper gates were 26 ft high and weighed about 100 tons; the lower gates were 64 ft high and weighed 500 tons each.

Of unique design, the power house is an example of French ingenuity. It was designed for six vertical units, of 36,000-hp rating at 54.5-ft effective head, 660 cu ft per sec, and 93.7 rpm. with generators of 31,000 kva and 8,800 v. The 6-blade propeller runner of 18.5-ft diameter and weighing 52 tons, was suspended from the generator on a 72.5-ft shaft. The innovation consisted in providing, between the turbine and the generator, a sluiceway controlled by a double-leaf gate, for bypassing ice, trash, etc., and "idle" water. This in turn eliminated surges in the upstream canal and permitted downstream plants to be fed without interruption. Furthermore, at high water the operation of the sluiceway created suction beyond the draft tube and increased the efficiency of the turbine. This arrangement permitted a considerable decrease in the length of the power house, eliminated ice trouble at turbine intakes, and reduced the cost. In fact, the power house was only 590 ft long. It housed six generators 32 ft in diameter, and weighing 500 tons each. There were two overhead cranes of 120-ton capacity.

The transformers, located outdoors, were on the left bank of the canal, adjoining the power house. They were arranged in two separate sets of three each. One set of 8.8/220-kv was rated at 40,000 kva and boosted the power for the 220-kv line to Troyes and Paris. The other set, of 8.8/150 kv, was rated at 31,000 kva, and were connected to the line of Ile Napleon at Mulhouse. The transformers were hooded and cooled by forced-air circulation. They were so large that their hoods could house four automobiles simultaneously.

TABLE I. PLANNED UTILIZATION OF RHINE BETWEEN CONSTANCE AND STRASBOURG

NAMES OF PLANTS	DESIGN HEAD, FT	DESIGN *Q* CU FT PER SEC	INSTALLATION, HP
German-Swiss, Along Rhine River			
Schaffhausen	17.4	14,100	23,000
Rheinfall	83.0	14,100	113,000
Rheinau	40.2	13,800	54,000
Eglisau	36.0	14,300	47,000
Reckingen	28.2	16,800	44,000
Waldshut-Kadelburg	32.2	16,100	49,000
Albbruck-Dogern	32.8	31,800	97,000
Laufenburg	36.2	24,000	84,000
Saeckingen	18.4	34,000	58,000
Ryburg-Schwoerstadt	35.2	42,800	140,000
Rheinfelden	17.1	21,400	32,000
Augst-Wyhlen	24.6	28,200	60,000
Birsfelden	20.0	35,200	60,000
Total	421.3		861,000
Probable annual output, 4 billion kwhr			
French-German, Along Alsatian Canal			
Kembs	50.0	30,000	193,000
Ottmarsheim	47.5	30,000	200,000
Fessenheim	49.0	30,000	206,000
Vogelgrun	40.5	30,000	172,000
Marckolsheim	11.7	30,000	175,000
Sundhouse	41.7	30,000	175,000
Gerstheim	38.4	30,000	161,000
Strasbourg	39.4	30,000	154,000
Total	348.2		1,436,000
Probable annual output, 6 to 8 billion kwhr			

NOTE: Plants in roman are in operation; plants in italics are proposed or under construction.

LITIGATIONS HELD UP CONSTRUCTION

This ambitious project was submitted to the Rhine River Commission for approval. Germany could not protest since she was bound by Article 358. However, because of the navigation to Basel, an interested party, a certain Mr. Gelpke—a Swiss citizen—protested and went to court. It is a remarkable fact that Mr. Gelpke held up this great work for years. There are volumes of

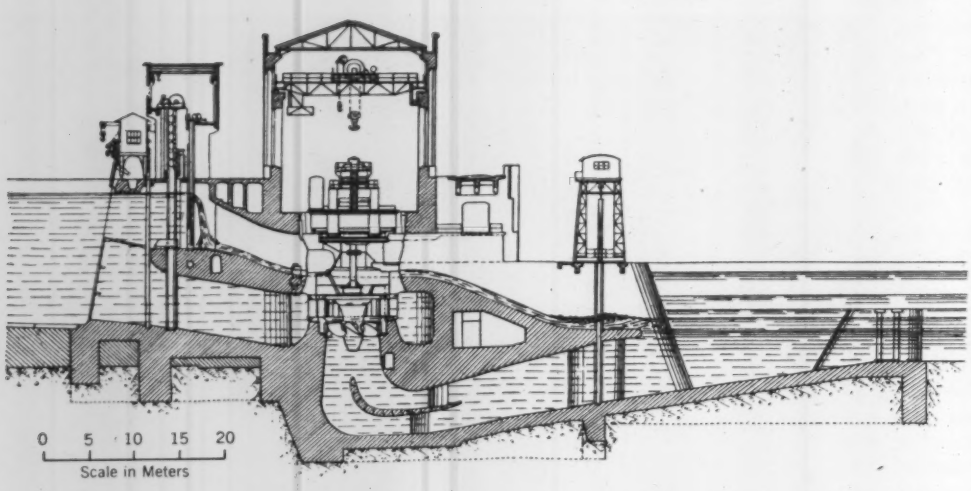


FIG. 2. SECTION THROUGH POWER HOUSE OF KEMBS PROJECT

evidence, expert opinions, legal debates because Mr. Gelpke was a Swiss citizen, and Switzerland was not a co-signer of the Treaty of Versailles.

He argued that:

1. The canal would be fully on French territory and therefore that navigation would be under French control, particularly in case of war.
2. The Rhine, as it was, was navigable all the year except when iced, or at low water. The canal would not help the ice condition, and the low water lasted only for a few days.
3. The difficulties of navigation through the Istein rapids were overexaggerated by France.
4. The cost of the canal would be so high that the condition of Article 358 stipulating that "nor shall it involve any increase in the tolls formerly levied" could not be maintained.

The French affirmed:

1. That it would be cheaper to build eight power houses and eight sets of locks on the canal, than eight dams on the Rhine River.
2. That less area would be inundated.
3. That the ice push of the Rhine would bypass the canal.
4. That navigation could proceed in the canal while the ice passed in the Rhine.
5. That the dams if built across the Rhine would have to bypass the largest floods, whereas all plants on the canal would be subject only to a flow of 30,000 cu ft per sec.

The French won and so in 1927 the Societé Energie Electrique du Rhin was founded. The power company undertook the financing of the canal, power house, and sluices (about 450,000,000 francs), while the French government assumed the cost of the diversion dam (about 170,000,000 francs), making the entire project total about $30,000,000.

VIEW OF KEMBS PROJECT FROM UPSTREAM—POWER HOUSE AT UPPER LEFT, LOCKS NEAR CENTER

CONSTRUCTION OF THE KEMBS DAM AND CANAL

Ironically enough, Germany, as part of her reparations, built this Kembs Dam and the 3.4 miles of the Alsatian Canal. This job involved:

470 acres of stripping
1,570 acres of appropriated land
9,550,000 cu yd of excavation
161,000 cu yd of rock excavation
610,000 cu yd of reinforced concrete

Nowadays, when an airfield can be created over night, such a project would be a small matter, but 15 years ago this was the largest job in Europe. No European equipment had sufficient capacity for such unprecedented work, and American excavators were imported. Among the sixteen excavators, mostly small, were two draglines with a 150-ft boom and a 4.5-cu yd bucket, and two with a 1-cu yd bucket. Construction men made pilgrimages to Kembs to gasp at the novel monsters.

It is interesting to compare the Kembs project and the Alsatian Canal with the Wheeler project of the TVA, and this has been done in Table II.

On October 9, 1932, the President of the French Republic, Albert Lebrun, flanked by Edouard Herriot, then Prime Minister, officially opened Kembs and dedicated it for useful service to mankind.

TABLE II. COMPARISON BETWEEN KEMBS AND WHEELER PROJECTS

PROJECT FEATURES	KEMBS	WHEELER
Navigation:		
Min. draft, ft	25	9
Yearly tonnage, tons	8,000,000	22,000,000
Locks:		
Number	2	1
Size, ft	{82 × 600} {82 × 328}	60 × 360
Lift head, ft	55	53
Dam:		
Length, ft	590	6,285
Height, ft	115	72
Design, flood, cu ft per sec	212,000	687,000
Min. flow, cu ft per sec	9,900	4,070
Power houses:		
Number of units	6	8
Size, kva	31,000	36,000
Ultimate capacity, kw	144,000	256,000
Transmission lines:		
First, kv	150	110
Second, kv	220	154
Quantities:		
Excavation, cu yd	9,710,000 (incl. canal)	550,000
Concrete, cu yd	610,000	627,000
Time of Construction:		
Dates	Jul. '27–Oct. '32	Jan. '33–Nov. '36
Period	5 yr. 3 mo.	3 yr. 11 mo.
Cost	$30,000,000 (incl. 2 units)	$35,000,000 (incl. 4 units)

Toward Better Drainage Structures

Experience and Observations Indicate Need for Careful Field Investigations

By CECIL K. OAKES, ASSOC. M. AM. SOC. C.E.
ASSOCIATE ENGINEER, MISSISSIPPI RIVER COMMISSION, VICKSBURG, MISS.

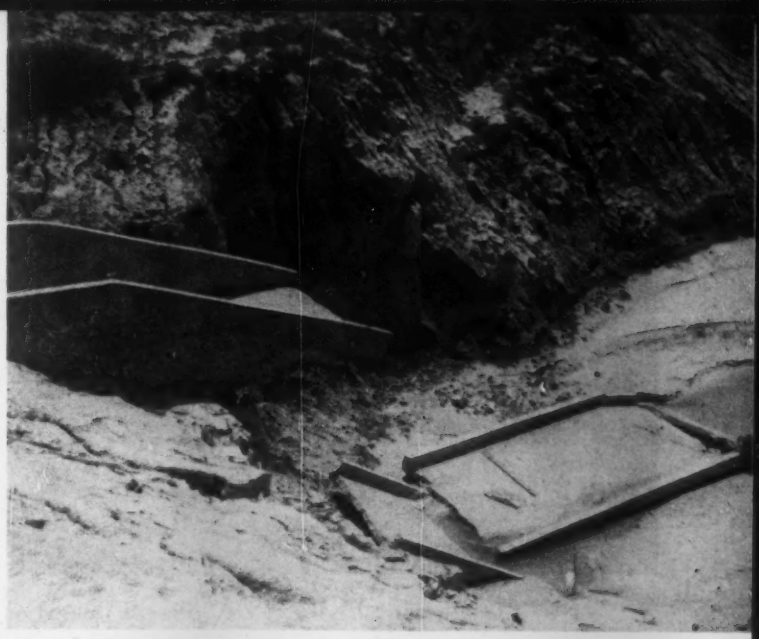
ACCUMULATED surface runoff is potentially far more destructive than is often realized. On airfields and similar projects it is a frequent cause of trouble. The energy between points of accumulation and disposal must be dissipated, and some proper means must be provided or erosion is bound to result. Certain small details of structures will often mean the difference between a satisfactory drainage system and one which requires frequent repairs and considerable maintenance.

Water flowing over ground surfaces, whether graded or in the natural state, tends to form rivulets resulting in erosion. The erosion increases as the slope of the surface and the accumulated discharge increase. Suitable vegetative cover prevents erosion where the accumulated discharge is relatively small and channelization has not developed. Limitation of velocities by limiting the slope of the ground surface or ditch is necessary on freshly graded airfields. The use of berms and ditch checks is another solution. Where ponding is permissible, the pool serves as a stilling basin. However, if the slopes are too steep, erosion may occur at discharge rates too low to cause ponding. The placing of sod may be necessary to prevent erosion if the slopes cannot be kept sufficiently low.

In computing velocities in ditches, it is important to remember that the velocity obtained is the average for the reach and that erosion will usually start at a section where the velocity is higher than the average. When erosion has started, the turbulence caused by discontinuities in the flow pattern often causes erosion to progress very rapidly. It is important, therefore, to keep the maximum velocity sufficiently low to prevent any erosion whatever.

It is nearly always economical to keep the water on the ground surface over as great a distance as practicable. This results in considerable saving in pipe length, and usually lengthens the critical runoff time by retarding the flow, which in turn will permit a reduction in required pipe size.

LACK OF CUTOFF WALLS LET WATER PASS UNDER THIS CHUTE



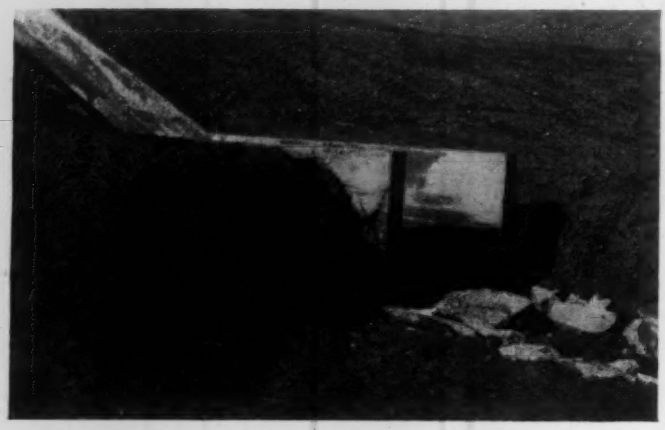
SUPPORTING EMBANKMENT WASHED OUT BY WATER SPILLING OVER LOW SIDES OF CHUTE

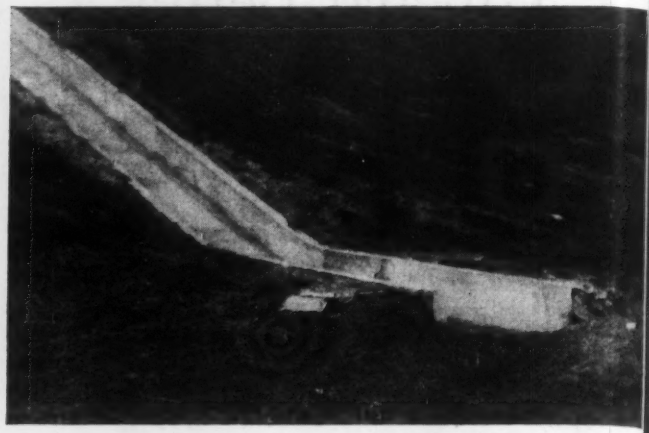
Care must be taken when placing inlet gratings with respect to the ground surface. If these gratings are placed too high, the water will bypass an intercepting inlet, will pool, and will cause a soft area around the collecting inlet. On the other hand, if the grating is placed too low, as is often done to "attract" the water, excessive erosion will occur over the adjacent steep slopes. Where the water is to be intercepted along a swale, it is good practice to raise the ground surface on each side of the inlet sufficiently to concentrate the stream over the grating. On newly graded airfields, it will be found that small roots and other debris can be expected to clog the gratings for a period of about a year after completion of the field. If erosion occurs around an inlet, the slopes near the structure may have to be reduced. This should be done by raising the inlet, as otherwise the area of erosion will merely be moved farther from the structure.

PIPE SIZES

In a long pipe, it is often more economical to employ the minimum pipe size commensurate with the maximum obtainable slope, and to provide special means of dissipating the energy at the exit. If the pipe line is short, economy may dictate a larger pipe size placed on a flat slope to reduce the velocity, thereby eliminating the necessity of any stilling basin. It must be determined whether the control is the pipe line or the entrance to the pipe, in order to ascertain the limiting effective slope of the pipe. It is possible to obtain the necessary gradient by placing the pipe on a rather flat slope but at a sufficient depth to operate under head to pass the design discharge. The pipe should, of course, be placed on a sufficient slope to obtain cleansing velocities when it is partly full. Investigation should be made to ascertain the tailwater elevations, as a high tailwater under relatively low discharge conditions may result in a reduced gradient through the culvert and consequent deposition of eroded material therein. The arrangement described has the advantage of lowering the velocity when the pipe is partly full, so that high discharge velocities do not occur as frequently as when the pipe has a steep slope.

No rule can be established as to the necessity for headwalls and wingwalls. A practice often used is to omit the headwall on the downstream end and extend the pipe culvert further downstream than would be done if a headwall were constructed. This is permissible if conditions are such that no headwall is necessary at the pipe exit. It should be determined, however, that omission of the



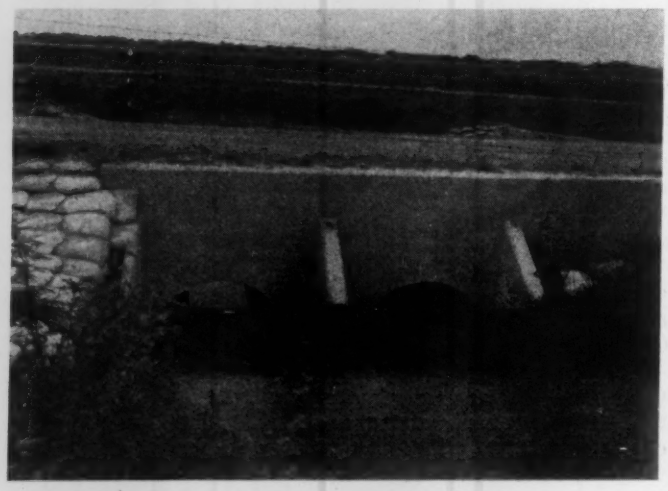


LEFT, STILLING BASIN SET TOO HIGH (AN INVITATION TO FAILURE); RIGHT, STILLING BASIN PROPERLY SET

headwall will not result in failure of the pipe at the exit or the sloughing off of embankment material. If the water's energy cannot be dissipated at the outlet without objectionable erosion, either a stilling basin must be provided or the channel must be protected. For best energy dissipation it is usually desirable to have the pipe outlet submerged if no stilling basin is used. An approximate determination of tailwater conditions is usually possible. Submergence of a pipe exit has one objection—the tendency to soften the embankment material by saturation. It has been found, however, that sloughing is often no worse under this condition than with lower tailwater levels.

PREVENTION OF SLOUGHING AND SEEPAGE

Headwalls and wingwalls have a specific function to perform—the prevention of sloughing. If an embankment is permitted to slough at a pipe outlet, complete stoppage of the pipe is often the result. Since operation under low heads is the rule rather than the exception, there is not sufficient pressure to force the material out of the pipe. It is generally sound practice to provide head and wingwalls where pipe outlets are in embankment fill. Also, some undisturbed material is unstable when wet and therefore requires a headwall. Observation of local structures is a valuable guide in this connection. Flow from adjacent areas, especially embankments, should not be permitted to enter the outfall ditch by flowing over and around a headwall or pipe outlet, but should be let down by means of a chute or diverted away from the pipe outlet.



DROP STRUCTURE ON UPSTREAM SIDE OF ROAD CULVERT, WHICH CONTROLS VELOCITY BY FLATTENING THE DITCH GRADE

Considerable care must be exercised when headwalls, aprons, and chutes are placed on embankment fill of questionable stability. It is extremely difficult to compact the material in most embankment fills sufficiently to prevent seepage from the upstream side of chutes and to keep wet material from flowing from under headwalls and aprons. Aprons and headwalls should be placed on undisturbed material, if practicable, rather than on embankment fill. To prevent seepage from the upstream side of chutes, and the flow of wet material from under aprons and headwalls, adequate cutoff walls are usually essential. Wood structures should be constructed in place and not prefabricated and placed as a unit; the latter method too often results in failure to put sufficient material under the structure to give uniform and adequate support—especially true of aprons and floors.

It is often necessary to provide protection for a reach from the apron to a ditch section by means of riprap or sod. The nature of the material encountered will, of course, dictate which is to be employed. An outstanding advantage of sod is the binding effect of the roots. Sandy material usually needs protection more than any other; also, it is generally the most difficult to protect. For this reason it is often necessary in sandy soil to provide a stilling basin. More stable materials can be successfully treated with riprap or sod.

At the discharge end of a chute or pipe outlet, a stilling basin should nearly always be used if super-critical velocities occur. An analysis should be made to determine the flow conditions to be expected. If the material encountered does not offer sufficient resistance to erosion, a stilling basin should be constructed of masonry or wood, preferably the former. To obtain the best results from a stilling basin, it should be placed so that the tailwater will submerge the end sill but at the same time not drown out the jump. The stilling-basin floor should be placed in the natural ground whenever possible. The invert of the outflow channel should be at the same elevation as the end sill crest and should have a slope flat enough to maintain low velocities.

Observation of culverts and drainage systems, particularly newly constructed ones, after a severe storm in nearly any locality, will provide examples of some of the conditions discussed. Such observations are strongly recommended as a guide in the design of drainage structures. Any methods of determining runoff quantities will serve their ultimate function best if supplemented by care and judgment in the design of the structures themselves.

Should Surface Carriers Participate in Air Transport?

By RUSSELL B. JAMES

VICE-PRESIDENT, BURLINGTON TRANSPORTATION COMPANY, CHICAGO, ILL.

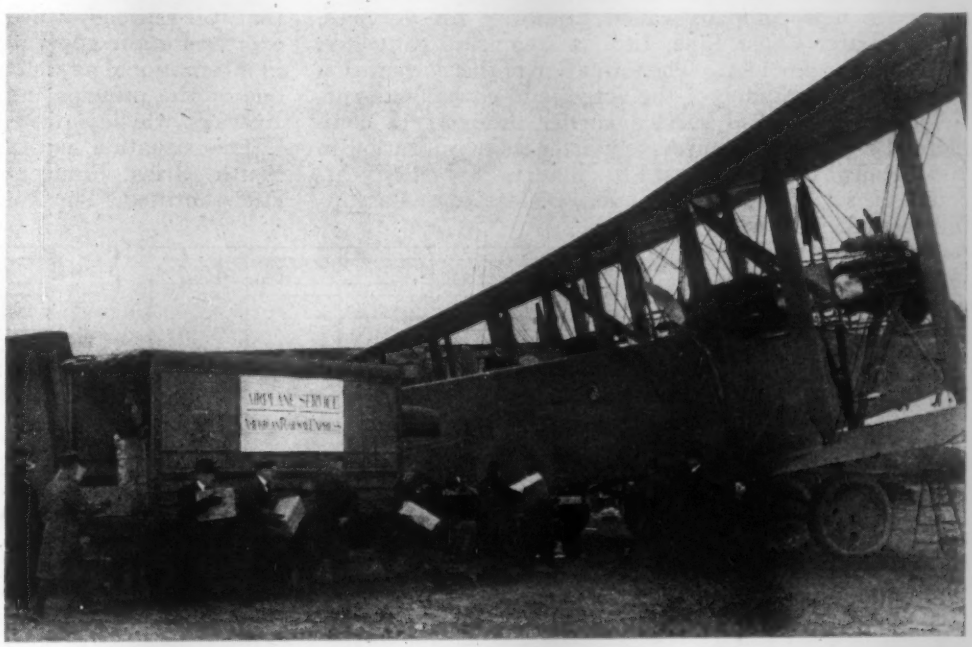
STIMULATED by the wartime demand for rapid transportation, the volume of air-borne traffic throughout the world has expanded greatly. The belief is widely held that, following the war, traffic moving by air will be greater than ever before. This belief, coupled with the fact that many surface carriers propose to enter the field of commercial aviation, has aroused widespread public interest and has provoked sharp controversy. In this article Mr. James briefly reviews the history of the relationship between surface carriers and air transport to substantiate his opinion that the public interest will best be served by the entry of surface carriers into the air transport field. This paper was presented before the Illinois Section.

WHILE the subject of surface-carrier participation in commercial aviation has become of general public interest only recently, various forms of association between surface and air transport go back to the beginning of commercial aviation. Eastern railroads played a major part in the early development of air transport. In connection with a pioneering flight from New York to Philadelphia by Charles K. Hamilton in 1910, the Pennsylvania operated a special train whose departure and arrival were scheduled so that comparative timing could be made between it and the Hamilton plane. On May 29, 1910, a few months before Hamilton's New York–Philadelphia flight, Glen Curtiss succeeded in flying from New York to Albany in two hours and 51 minutes of flying time. The New York Central Railroad operated a special train in connection with that event, which was perhaps the earliest inter-city flight by heavier-than-air craft in this country.

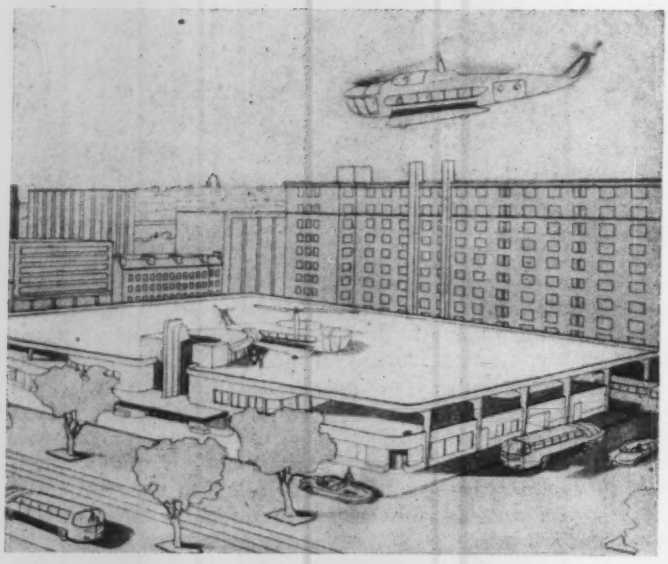
In the infancy of Transcontinental Air Transport, Inc. (merged in 1930 with Western Air Express to form Transcontinental and Western Air, Inc.) the Pennsylvania Railroad, which owned an interest in the corporation, extended to the air line many of its facilities. The first transcontinental air schedules, established in 1929, utilized Pennsylvania passenger service between New York and Columbus, Ohio, and Santa Fe service between Waynoka, Okla., and Clovis, N. Mex. This was before night flying became feasible. Northeast Airlines, Inc., serving northern New England and certain Canadian points, and recently authorized by the Civil Aeronautics Board to extend from Boston to New York, was sponsored and developed jointly by the Boston & Maine and Maine Central railroads, which still hold minority interests in it.

The predecessor of the Railway Express Agency, Inc., controlled jointly by a large number of railroads, was the pioneer in the use of aircraft for the transportation of merchandise. As early as 1910, it transported a cargo of silk from Dayton to Columbus, Ohio, in a Wright biplane, the shipment having moved from New York to Dayton by rail. In 1919 an attempt was made to ship merchandise by air from New York to Chicago in a converted British bombing plane with a former Royal Air Force pilot at the controls. The plane was grounded in Pennsylvania by adverse head winds and the traffic was moved on to Chicago by rail. In 1927 regularly scheduled air express service was established. For a number of years the Railway Express Agency has performed the ground services, pick-up and delivery, and solicitation for the domestic air carriers and has vigorously promoted and advertised air express traffic, which has undergone an enormous expansion.

References to authoritative records of the aviation industry, such as the Aeronautical Chamber of Commerce year books, show that the railroads have been intensely interested in air transportation since its inception and that their attitude toward it has been realistic and friendly. It has been suggested that the active interest in air transportation recently manifested by the surface carriers constitutes a belated and grudging acknowledgment that aviation has now become a recognized factor in the transportation pattern. The active interest of several important railroads in the subject over a period of more than twenty years refutes this assertion.



ONE OF FIRST AIR CARGOES IN THE UNITED STATES WAS CARRIED IN 1916 ON A NEW YORK TO CHICAGO ROUTE



PROPOSED DESIGN OF BUS-HELICOPTER DEPOT
Prepared for Greyhound Corporation, Which Has Applied for Permit to Operate Local Helicopter Buses Over 49,130 Miles of Route

Inquiry into the history of the relationship between surface and air transport in Great Britain, and in some of the dominions and members of the British commonwealth of nations, likewise shows that the surface carriers, particularly the railways, have long shown an interest in aviation. Indeed they have gone much further in the actual operation of aircraft abroad than in this country.

In 1929 the four largest British Railways (which conduct extensive highway as well as rail transportation service) obtained from Parliament the necessary authority to operate air service with Great Britain and to the European Continent. In 1930 the Southern Railway announced that it had acquired a financial interest in Imperial Airways, and in 1933 the first railway-sponsored air service was established by Imperial between Cardiff and Plymouth.

In 1934 the four large railways and Imperial Airways formed a new company called "Railway Air Services, Ltd." Later Coast Line, Ltd., a steamship company, became a stockholder. The formation of this corporation marked the beginning of the active and continuous participation of British surface carrier interests in commercial aviation. Immediately after its organization in 1934, Railway Air Services, Ltd., inaugurated daily year-round air service between London, Belfast, and Glasgow, followed shortly with service connecting the important ports. This service was expanded, improved, and consolidated gradually until the outbreak of the war. In 1938 a governmental body, known as the Cadman Committee, was appointed to investigate civil aviation. In its report appears a finding that the railway companies were "making a useful contribution to civil air development."

At the beginning of the war the number of British railway-sponsored air lines had grown to 16, which operated approximately 80% of the total route miles licensed for air transport. The railways had invested 2½ million dollars in air carriers and 1½ million in development. The expansion and development were, of course, interrupted by the war, when all air service was suspended and all equipment and personnel requisitioned by the Air Ministry. Later a number of routes were reestablished to provide mail and other services.

In 1940 the Government requested the establishment of additional routes, some involving sea crossings, and a joint organization known as the Associated Railway Joint Committee was formed, on which each of the operating companies was represented. The exigencies of war, however, interrupted this program, and equipment and crews were pressed into the service of evacuating personnel and stores from France. In June 1940, domestic civil air service was restored and has been continuously in operation since. Despite bombings, the lack of navigational and meteorological aids, and manpower and equipment shortages, the railway-sponsored air carriers, since June 1940, have operated 6,000,000 plane miles and transported 200,000 passengers and 5½ million pounds of urgent mail and freight.

Following the war these carriers propose to establish complete air service between the principal cities in the British Isles and every important point on the continent west of a line drawn between Stockholm and Budapest. They propose, moreover, to conduct these operations without governmental subsidy. They have employed as adviser the former chief traffic officer of the British Overseas Airway Corporation, who is working up routes and schedules.

OTHER COUNTRIES

The dominant domestic air lines in Canada are Trans-Canadian Air Lines, owned by the Canadian National Railway, and Canadian Pacific Air Lines, Ltd., owned by the Canadian Pacific Railway. There has been a recent attempt in the Dominion Parliament to exclude Canadian Pacific from the air after the war. Apparently this action was due not so much to the fact that it is railroad-owned, as to the fact that pressure was exerted for one government-controlled air line to engage in international as well as domestic flying. In Australia, one of the principal air carriers is Australian National Airways, which is owned by five steamship companies.

The situation with respect to rail-air relations in South Africa, France, and Germany is described in a study entitled "The Role of Public Action in Transporta-

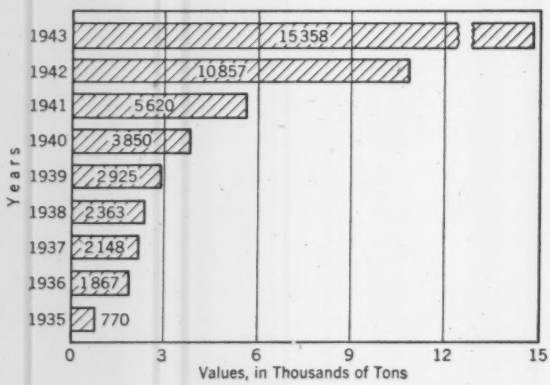


FIG. 1. TONNAGE OF AIR EXPRESS CARRIED BY DOMESTIC AIRLINES SHOWS EXPANSION
Data from the Railway Express Agency

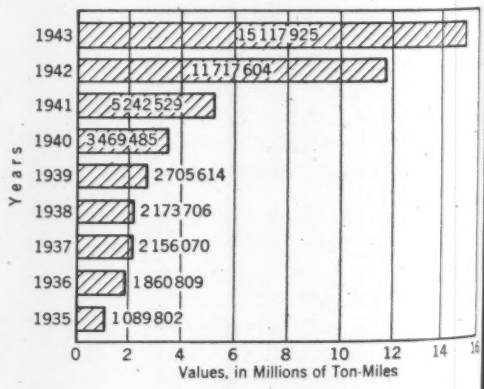
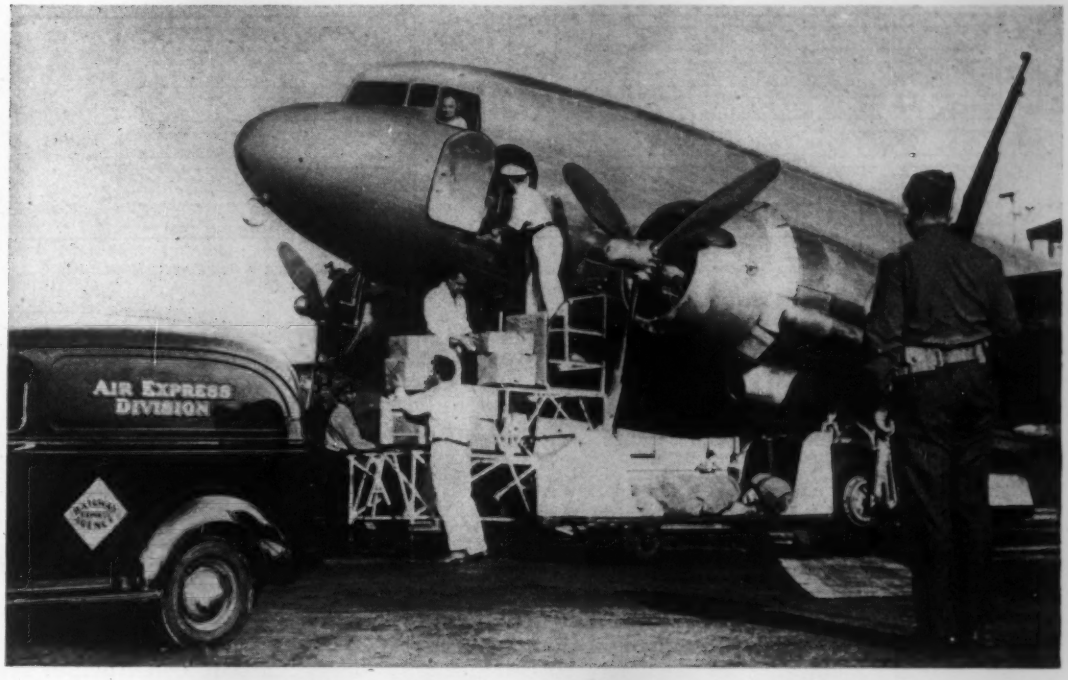


FIG. 2. AIR EXPRESS TON-MILES FLOWN BY DOMESTIC AIRLINES
Data from Civil Aeronautics Administration

tion Abroad," by Ludwig M. Homberger, Visiting Professor of Transportation, The American University, Washington, D.C., who says in part:

"Friendly relations of air carriers with rail and other operators have facilitated some degree of cooperation. British and Canadian railroads have financial interests in air companies. South African Airways, which operates all scheduled air services within the Union, is owned entirely by the South African railways. In France, a committee of the Transport Advisory Council, 'Fer-Air-Mer,' was in charge of coordination of rail, air, and ocean transportation. Combined return tickets were introduced. A similar kind of cooperation between railroads and air carriers exists in Germany. Tickets can be used there on railroads when scheduled flights have to be canceled for technical reasons, and baggage of air passengers can be checked at railroad stations without extra charge. No conflicts between air and other carriers are in evidence."



MODERN AIR CARGO CARRIERS FLEW OVER 15 MILLION TON-MILES IN 1943

As to prewar Germany, an excellent presentation of the advantages of the coordination of air and surface transport is found in an address made to the air transport group meeting of the International Chamber of Commerce in June 1935, by Martin Wronsky, Director of Deutsche Lufthansa. The speaker covered the advantages of both air-rail service and air-steamship service and the means of extending such collaboration. After reviewing some of the accomplishments which had already been achieved, Director Wronsky expressed the opinion that "there are still many possibilities to be worked out in the field of collaboration between the airplane and the railway, especially in regard to combined air-rail journeys. The creation of air-rail tickets, permitting the utilization of a combined service, seems to me highly desirable."

United Fruit Company, which for many years has operated steamships between United States ports and Latin America, established air service in Honduras in 1924, and continued to operate as an air carrier for four years, when Pan American came in.

From the foregoing it seems apparent that in the English-speaking nations, Latin America, and in France and Germany, the surface carriers, particularly the railroads and steamships, have long been keenly aware of the growing importance of air transportation and have sought and found opportunities to utilize it in connection with surface transportation as well as independently.

RAIL-CONTROLLED HIGHWAY CARRIERS IN THE UNITED STATES

The attitude of the American Railroads has never been antagonistic toward air transport. A complete analogy lies in the long-existing relationship between various American railroads and highway transportation. Many of the important bus lines in this country are under railroad control.

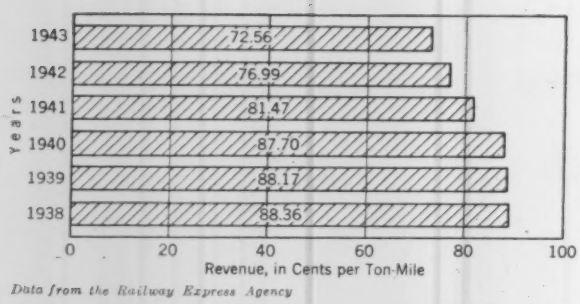
Even if the railroads desired and attempted to hamper commercial aviation, they could not possibly succeed, since service, rates, fares, accounting, and their practices generally would be subject to the jurisdiction of the Civil Aeronautics Board, which may revoke or suspend certificates for cause, and issue additional certificates over routes already served. Self-interest, moreover, would stimulate the surface carriers to provide high standards of service at reasonable rates in order to become and remain factors of importance in a rapidly growing field.

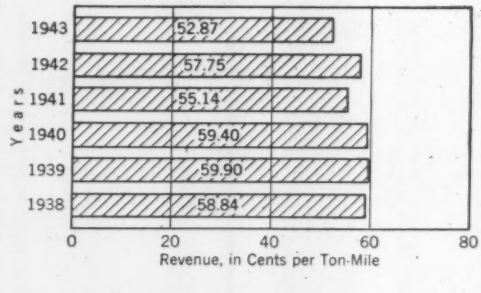
THE POSITION OF THE SURFACE CARRIERS

The railroads generally favor railroad participation in air transportation. As has been indicated, two railroads own interests in Northeast Airlines. A number of railroads through subsidiary corporations have applications on file with the Civil Aeronautics Board.

Greyhound Skyways and approximately twenty other bus lines are seeking the right to conduct air operations. Some of the bus applicants are railroad-controlled, but the great majority have no railroad affiliation. At its 1943 annual meeting, the American Trucking Associations adopted a resolution opposing the operation of an additional form of transportation by carriers already conducting one form. A number of truck lines, nevertheless, have applied to the Civil Aeronautics Board for authority to establish air service.

The only existing air line now under steamship control is American Export Airlines, Inc., a majority of its stock being owned by American Export Lines, a trans-Atlantic steamship company. Trans-Atlantic air operation was established in 1942. American Export Airlines' operating authority is temporary in character and subject to an order of the Civil Aeronautics Board requiring divestment by American Export Lines of control. A proceeding, which, if successful, will result in the acquisition of control of American Export Airlines by American Airlines, Inc., is now pending before the Board. [On





Data from the Railway Express Agency

(*Left*) FIG. 3. GROSS REVENUE PER TON-MILE OF DOMESTIC AIR EXPRESS ON NEW YORK TO TORONTO ROUTE OF TRANS-CANADA AIRLINES (*Right*) FIG. 4. NET REVENUE TURNED OVER TO DOMESTIC AIRLINES BY RAILWAY EXPRESS

November 2, 1944, subsequent to the presentation of this paper, an examiner's report containing an adverse recommendation was filed.]

Pan American-Grace Airways, Inc., known as Panagra, flies routes along the west coast of South America. It is owned equally by Pan American Airways Corporation and W. R. Grace and Company. Many of the trans-Pacific and Caribbean steamship companies, including Matson Navigation Company, Grace Lines, Inc., United Fruit Company, Waterman Steamship Company, and others, also are applicants for authority to conduct air service along their steamship routes. American South African Line has applied for routes between New York and South African points.

American steamship operators serving foreign countries and American possessions overseas have been very aggressive in their effort to obtain the necessary governmental authority to engage in commercial aviation. In this effort they have the support of the U.S. Maritime Commission, and Admiral Emory S. Land, its chairman, has been outspoken in their behalf.

There are now in operation seventeen domestic air lines and two, Pan American and American Export, engaged wholly in international, foreign, and overseas scheduled operations, under certificates of public convenience and necessity granted by the Civil Aeronautics Board. One of those carriers, All American Aviation, Inc., transports only mail and express. Many of the larger domestic lines are flying transoceanic routes for the transportation of military personnel and cargo.

An extensive air express service is conducted jointly by domestic airlines and the Railway Express Agency. Two essential functions are thus coordinated. Commodities are picked up and transported to the airport. The airline transports the cargo with maximum dispatch between airfields, and then the surface carrier delivers from port of destination to consignee. All classes of air cargo are handled and three types of service are offered—expedited air express, deferred express, and freight in full or part plane loads. A substantial part of this traffic moves a part of the way by air and a part by rail. The growth of air express is shown in Figs. 1, 2, 3, and 4.

PRESENT LAWS

Section 401 of the Civil Aeronautics Act of 1938 establishes standards governing the issuance of certificates of public convenience and necessity to new applicants and to existing air carriers desiring to extend their service. It contains no provisions designed to exclude or limit surface carriers which make the statutory showing. Section 408, among other things, covers the transfer of air carriers or air carrier operating rights. That section contains a proviso under which it is necessary for a surface carrier to show "that the transaction proposed will promote the public interest by enabling such carrier . . . to use aircraft to public advantage in its operations and will not restrain competition." In no other section of the Act is there language imposing any limitation upon surface carriers.

The Civil Aeronautics Board has accorded an extremely narrow construction to the quoted language and has held in effect that it limits the rights of surface carriers not only in connection with the proposed acquisition by purchase or stock control of air-carrier operating rights, but also in connection with applications for certificates of public convenience and necessity. Ultimately this issue must be settled by the courts unless in the meantime the Board itself reconsiders the subject and modifies its position in the matter.

Most of the states have enacted statutes on the subject, although in some cases such legislation covers only safety, airport construction and maintenance, and related matters. I find no state legislation discriminating against surface carriers, and the proposed uniform bill on this subject, recently submitted to the National Association of Railroad and Public Utility Commissioners by a special aviation legislation committee which has been working for a considerable period, contains no provisions placing surface carriers in a position different from that of any other applicants with respect to the right to engage in civil aeronautics. Some state statutes expressly authorize railroads to engage in air transportation.

PUBLIC INTEREST IN TRANSPORTATION MEDIUMS OFTEN FORGOTTEN

It is regrettable that in controversies of the type which has arisen between the air carriers and the surface carriers, and the somewhat involved legal background presented, the paramount question, the interest of the public, is likely to be forgotten, since the principals are motivated largely by self-interest.

From the standpoint of public interest, and disregarding the legal complexities which surround the issue, the surface carriers seem to occupy the stronger position, since they already have in operation many of the facilities required to conduct air service, and employ personnel with broad knowledge of the areas to be served and experienced in most phases of transportation. In addition, the coordination under common management of two or more types of transportation service has over and over again been proved to make for economy and better service to the public.

The expressed fear of some aviation spokesmen is that the surface carriers desire to enter commercial aviation in order to hamper or destroy it. If such a result were even remotely possible, great caution should be exercised in granting surface carriers authority to fly. The existence of strong public controls embracing rates, fares, service, safety and other factors, the competition factor, the long and satisfactory experience with railroad-affiliated highway transport, and the extensive experience in Great Britain and elsewhere with railroad-affiliated air transport, collectively should alleviate that fear. The history of rail-air relationships, moreover, demonstrates that the surface carriers never have entertained any such sinister designs.

Basic Magnesium—the Desert Giant

I. Development of the Vast Project

By J. R. CHARLES, M. AM. SOC. C.E.

CHIEF ENGINEER, MAGNESIUM ELEKTRON LTD., CLIFTON JUNCTION (NEAR MANCHESTER), ENGLAND

WAR needs know no limits, brook no interference. The impossible has to be accomplished—somehow. Specifically, a 120-million project had to be developed from vision to reality, from sagebrush to production, all in 15 months. Even superlatives are inadequate to do justice to such tremendous accomplishments. Today Basic Magnesium has a production capacity surpassing that of the entire world prior to the war. Background and overall considerations are described in this first paper of the series, by Mr. Charles.

MAGNESIUM has been referred to as "the wonder metal of the twentieth century." It is the lightest of the common metals, silvery white in color. With a specific gravity of 1.74, it is but two-thirds the weight of aluminum and one-fourth that of iron. Although not occurring in the free state, magnesium is the eighth most abundant element and the sixth most abundant metal, as the crust of the earth contains about 2.07% in the form of compounds.

Magnesium was first isolated by Davy in 1808. More recently it was found that it could be produced by electrolyzing anhydrous magnesium chloride, the metal being deposited at the cathode and chlorine being evolved at the anode. This process had developed to a high state of efficiency by the end of World War I.

The Dow Company, producing the metal efficiently by a magnesium chloride process, was, by 1927, about the only producers outside Germany. Today there are several other processes, but by far the greatest production is by electrolysis. Although metallic magnesium was isolated approximately 16 years before aluminum, yet owing to the simpler metallurgical processes involved, aluminum was used first as a construction material.

In the pure state magnesium is comparatively soft. While it has a reasonably high elongation, its mechanical strength is low. However, when alloyed with other metals, particularly aluminum, zinc, cadmium and manganese, it possesses high mechanical strength and elongation properties, suitable for most construction. Its melting point is at approximately 625 C, and it can be welded. A new application of the Heliarc process will greatly benefit an already easily welded metal.

The history of magnesium has been marked by continual lowering of costs, improved methods of manufacture, and rapidly increasing use. The following qualities of Elektron magnesium base alloys speak for themselves:

Relative strength (*density ratio*):

Elektron	11.1
Duralumin	9.3
Heat-treated nickel chrome steel	7.0
Mild steel	3.6

Castings—Properties equal to those of aluminum and 40% lighter

Machining—Extremely simple—good normal speeds of 4,000 ft per min

Fire hazard—Cannot be ignited below the melting point

Between 1908 and 1920 the first magnesium base alloys, under the trade name "Elektron," were developed. Problems relating to the technique of casting, rolling, extrusion, forging, and welding were also tackled, and by 1927 Elektron alloys were ready to take their place along with older light metals in the field of industrial applications. These alloys were imported into Britain in 1922 and from then on the demands, as techniques improved, increased rapidly until 1936, when designs, data, and "know-how" were purchased from the I. G. Farbenindustrie and the first electrolytic process was started in England. Thereafter the plants expanded continually to meet the growing demands of the automobile and aircraft industries.

After the sad days of the fall of France, the heavy incendiary raids on Britain, and the urgent necessity for a huge expansion of the air forces, the greatly overloaded and continually expanding British plants were unable to meet the terrific increase in the demand for magnesium. America, ever watchful, had started a great expansion of the industry. The Dow Company, anticipating this, had increased its capacity and the War Production Board ordered further large expansions. Even these, however, left supply far behind the rocketing demands of the war. There was suddenly no time for waiting or developing technique—production in great quantities was wanted and wanted quickly. From 1940 through 1942, the WPB ordered the construction of 14 new plants, the largest of all being the Basic Magnesium Plant at Las Vegas, Nev.

Towards the end of 1940 a Cleveland concern, Basic Refractories, having acquired magnesite concessions in northern Nevada for refractory brickmaking, and knowing the urgent need for magnesium metal, approached the government with the proposal to call in the English concern. As a result Magnesium Elektron Ltd. was requested to send technicians and data to the United States to examine the prospects and state whether a scheme for the production of 11,000,000 lb per annum could be set up. Three of the company's officials set off with the required information and after an exciting time at sea, by

INTERMEDIATE STEP—30 TONS OF CALCINED MAGNESITE IS HAULED IN EACH TRUCK-TRAILER UNIT BETWEEN THE MINE AT GABBS, NEV., AND THE REDUCTION WORKS

GABBS VALLEY PLANT FOR MINING AND CONCENTRATING MAGNESITE

means of three separate ships and two lifeboats, eventually reached the United States in June 1941.

The raw materials were examined and found suitable but the process, as then established, required peat moss, of which the only suitable supply was in Canada. At that time research had nearly reached the stage where this material could be eliminated, but the Army Air Corps, in control of plant design, wanted a definite established process and could not wait for pilot plants. Schemes were hastily prepared for a complete plant; were re-estimated for double and then again for triple size; and finally an order was issued for a plant ten times the original size—that is, with a capacity of 112,000,000 lb per annum. This was a gigantic undertaking for one project, the planned output being greater than that of the entire world prior to World War II.

With little but memory to work upon (the data, of course, were lost at sea), layouts and estimates were rushed through. By August 13, after only $2^1/_2$ months, the contract was placed to build this mammoth undertaking under Defense Plant Corporation control and finance. Start of production was expected in about 12 months or less, and instructions were given that time was to be the only consideration.

HOW THE PROCESS WORKS

The general flow of material from mine to finished alloy may be considered under five main classifications or objectives.

1. *Crude ore.* Magnesite (magnesium carbonate), the principal raw material reclaimed from open mines, is treated in a concentration plant near the mine. Ore is crushed, then ground. Concentrating, screening, and calcining through roasters produce calcined magnesite.

Two main fine-ground products—raw magnesite concentrates and calcined magnesite—are produced direct from the ore at the mine near Gabbs in northern Nevada, and prepared ready for shipment more than 300 miles by highway to the reduction plant.

2. *Briquettes for chemical reaction.* Subsequent operations in the reduction plant are shown schematically in Fig. 1. Raw materials are raw magnesite concentrate (from Stage 1), calcined magnesite (from Stage 1), coal, peat, recovered dust, and potassium salts.

Storage for each is provided. Automatic equipment weighs out the set quantities and to the dry powder is added magnesium chloride solution (recovered in part from the process of Stage 3) to form a binder. The resulting dough is formed into small briquettes and passed through a pre-drying stage, then through low-temperature kilns under a reducing atmosphere to form hard-baked, porous briquettes.

3. *Magnesium chloride.* The briquettes are loaded into refractory-lined, electrically heated, vertical furnaces, and in the presence of chlorine gas, at a temperature of about 900 C, the chlorine reacts with the carbon and magnesium oxide, according to the known reactions,

$$MgO + C + Cl_2 = Mg{\cdot}Cl_2 + Co$$

$$2MgO + C + 2Cl_2 = 2Mg{\cdot}Cl_2 + Co_2$$

Molten magnesium chloride (anhydrous) is tapped from the bottom of the furnace at intervals and passed to Stage 4. Waste gases from the furnaces, containing hydrochloric acid and chlorinated hydrocarbons, are washed in water-circulated wash towers for recovery of HCl and the final products are treated with caustic solution before emission to the atmosphere. The collected HCl is passed to a special plant for neutralizing with MgO and filtration to form $MgCl_2$ (hydrous) used in Stage 2.

4. *Electrical separation.* The anhydrous $MgCl_2$ forms the electrolyte in a series of electrolytic cells and under a temperature of about 700 C, at low voltage and high current, Mg (electro-positive) is liberated at the cell cathodes and Cl_2 gas (electro-negative) at the anodes. After exhaustion and filtration, this gas is recirculated and used in Stage 3. The metal, as liberated, rises in globules, floats on the surface of the electrolyte, and at regular intervals is collected into "crude metal" blocks. Burning of the metal in the cells is prevented by a skin of flux spread over the surface.

5. *Refining and alloying.* The crude metal, impure by virtue of flux and electrolyte inclusions, is then reheated in large (2-ton capacity) crucibles, fluxed for precipitation of impurities, and alloyed according to the standard required. The alloy structure is controlled by the temperature of alloying, the cooling rate, and the pouring temperature. The final products, in the form of ingots (5-lb) or billets up to 16-in. diameter, or slabs for rolling, are turned out under careful metallurgical control.

In considering the problem of plant location, magnesite was available in northern Nevada and also in the State of Washington. The next most important requirement was power, of which some 200,000 kva was needed. This presented a problem in view of the vast expansion of war industries, but it was finally found that the only power

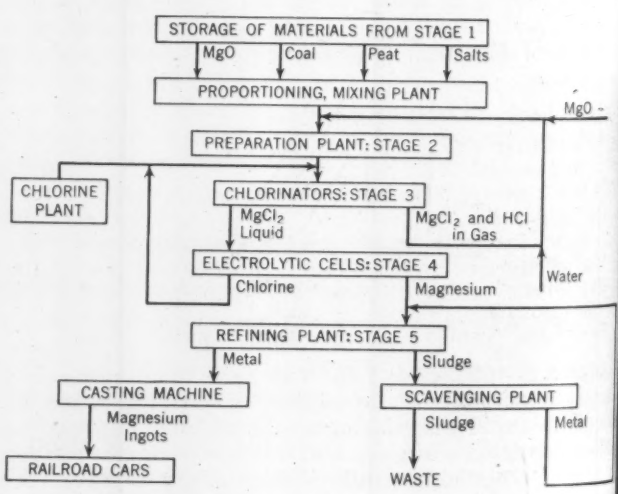


FIG. 1. FLOW SHEET FOR MAIN REDUCTION PLANT

LONG CONVOY OF TRUCK-TRAILERS USED IN TRANSPORTING MAGNESITE ACROSS THE NEVADA DESERT, BETWEEN GABBS AND THE REDUCTION PLANT, OVER 300 MILES

available was from Boulder Dam, the Grand Coulee source having been earmarked for other purposes.

Next, a large quantity of water was needed and in a state such as Nevada, a large part of which is desert, this was no simple problem. This indicated a location near to Lake Mead, formed by Boulder Dam. It was also imperative to minimize the length of power lines on account of cost and power loss, so sites near Boulder City were examined.

ADAPTING SITE CONDITIONS

The country is barren and mountainous. After thorough investigation, a site was chosen about halfway between Boulder City and Las Vegas on the Union Pacific Railroad's Boulder City branch, occupying roughly an area $2\frac{1}{2}$ by $1\frac{1}{4}$ miles on the southwest side of the state highway. The topographical conditions at the site were reasonably favorable, the slope fairly gentle. It was possible to locate the reservoir for the water supply at the highest point, at the southeast, to permit a gravity flow throughout the plant and also for the effluent, and to dispose of 15,000,000 gal per day of waste without pumping—in a wash at the northwest, where no damage would be done by this effluent.

Also on the high ground, next to the reservoir, is the town site, over a mile long. Then comes the reduction plant in the center, occupying an area $1\frac{1}{2}$ by $\frac{3}{4}$ mile, with its axis running east and west, and still further north are the disposal ponds.

The arid deserts of southern Nevada are not ideal for heavy construction in that temperatures are consistently high and in summer reach 120 F in the shade. Structural steel is at times too hot to touch with the bare hands, and there is practically no shade from the intense sun. From time to time the almost perpetual winds whip up sandstorms, fortunately of short duration, but nevertheless irritating, as they require the cessation of work and damage erection tackle. Water is, of course, the staff of life in this country. It all had to be brought to the site by trucks in the early days and distributed to hundreds of improvised drinking fountains. Salt tablets were provided to combat heat prostration, which accounted for so many collapses when Boulder Dam was built.

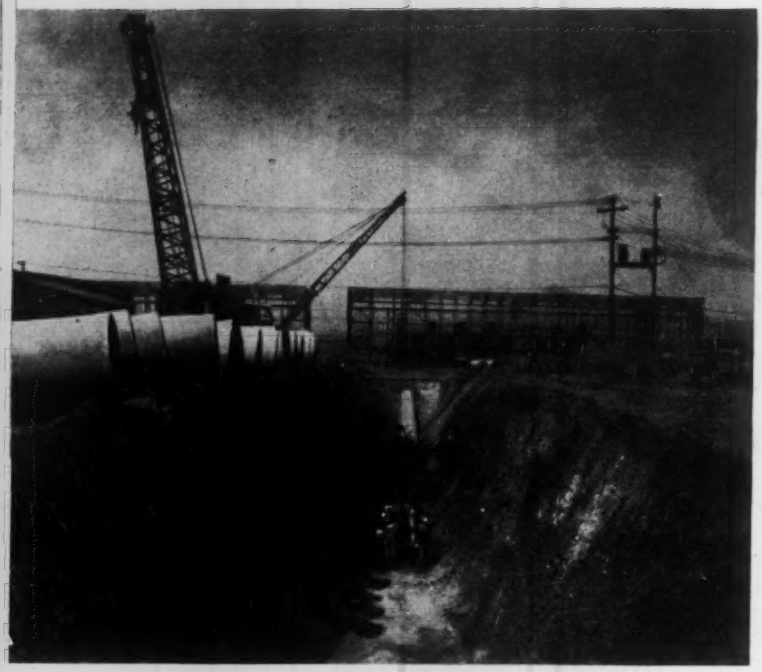
THE SITE LOOKED LIKE THIS

Buzzards, jack rabbits, spiders, and coyotes were a little too plentiful, though the activities of bulldozers and scrapers discouraged them somewhat. In addition to the heat, dryness, and dust, rain could also be a trial. It occurred only about four times during construction, but was extremely heavy while it lasted, flooding the roads and washing away equipment. Nevertheless, the work could go on practically non-stop for 24 hours a day—winter and summer. Further, the compactness of the ground rendered timbering of all but the deepest excavations quite unnecessary.

Boulder City had few surplus accommodations and Las Vegas not a great many more; consequently it was necessary from the outset to provide for housing accommodations for construction and operation crews. This was tackled in a very practical manner. A tent camp for single men was provided with bath houses, common rooms, and mess hall with stores for supplies of clothing, newspapers, candies, and drinks. This well-built and regulated "town" was known as the largest tent city in Nevada—with 4,000 inhabitants. The tents and other buildings were air conditioned.

Adjacent to this, again with communal laundries and bath-house facilities, was a trailer park, so organized that families could dwell in company trailers or park their own trailers. Electric connections were available for lighting and cooking, so that a family could, in an incredibly short time, have the counterpart of a small home. In addition, on the south side of the plant, adjacent to the highway, a town was built to accommodate key contractors' personnel and later plant operators. It was complete right down to school, stores, library, and churches. Since local labor was quite inadequate to provide the 12,000 men needed during construction, careful attention to living conditions was the only way to get workers into the desert and away from the heavy war industries on the West Coast, with their superior facilities and amenities. The labor turnover was colossal, and the matter of supply of labor in sufficient quantities for the job was, in itself, a major feat.

Pressure of war did not permit a long and detailed investigation of all possible factors affecting plant layout,



PLACING REINFORCED CONCRETE PIPE FOR STORM DRAIN
This Is a Typical Trench and Excavation

as would be done in peacetime. Nevertheless, all major factors were allowed for. Thus it was imporant to:

1. Arrange the plant so as to provide, in so far as possible, for a continuous flow of materials with a minimum amount of "back haul."
2. Make the most direct connection with the Union Pacific Railroad from the west to avoid any possible relocation of the existing lines.
3. Avoid construction over major "washes" where there would be danger of washouts from the sudden cloudbursts which are typical of that country.
4. Take advantage of the natural slope for water supply, effluent disposal, and drainage services.
5. Locate the route for the effluent in such a way as to provide the maximum distance from the effluent basins to the Las Vegas "wash" to make effective use of the high rate of solar evaporation to minimize the amount of waste water that might eventually flow back to Lake Mead. (Solar evaporation in that locality is estimated at 8 in. per month in the summer.)
6. Locate electrical power main switching stations to avoid, in so far as possible, chemical fumes from the plant.
7. Locate the town site where, under prevailing wind conditions, it would not be subject to fumes.

In general, the layout hinges around the metal plant arranged centrally along an east-west line, and consisting of 10 metal units, each rated at 5,600 tons of magnesium per annum. The whole plant is laid out on the west side of the Boulder City–Las Vegas highway. With the prevailing southwest wind, any escaping smoke or fumes are blown to the northeast or desert area. The railroad connection from the west connects with the branch line of the Union Pacific Railroad.

Within the boundary fence to the north is the incoming baled peat storage area and adjacent to that the coal storage. At the preparation plant are the magnesite silos, the main pellet-producing plant, and the plant for producing the magnesium chloride binder. Finished pellets are delivered to each of the ten metal units. The crude metal which results from the electrolysis is collected by road transport and delivered to the south side of the refinery. There it is alloyed, cast into ingots, bundled, and delivered to the railroad on the north side.

General services, such as workshops and stores, are on the south end of the site, with construction and store materials still further south. The two main transmission lines coming in from Boulder Dam split through the main control station, feeding to the main substations. The chlorine plant is located to the west; and its raw material—salt—is stored to the northwest of the chlorine production buildings. The production from this plant is shipped out at the south as liquid chlorine or delivered as a gas to the metal units by pipe line.

At the extreme southeast are the water terminal reservoirs, and as this is the highest ground, supply the whole plant by gravity. Approximately half of the plant water is recirculated cooled water. The half that is wasted is collected near the north boundary at the effluent neutralization agitators and again delivered by gravity to the effluent disposal ponds at the north. The center of the town site, on high ground, is approximately a mile from the center of the plant. On the east side of the main highway are the temporary trailer camp and construction contractors' dormitories, and beyond them the sanitary disposal plant and the immense trade effluent disposal ponds. In all, the facilities, including manufacturing, housing, and disposal, occupied over 5 sq miles.

PROGRAM OF CONSTRUCTION

It was desired to obtain metal from the plant at the earliest possible moment. But since the whole project was so immense that it could not possibly be completed all at once, and since each of the 10 main metal units could be operated independently provided its ancillary feed facilities were available, the entire layout was designed to get Unit No. 1 (West Unit) into operation first, the other units to follow in succession, so as to step up production steadily over a period of about 12 months.

The basis of No. 1 unit and its collateral installations therefore was agreed upon first, and a construction program was prepared with the object of producing metal by the end of August 1942. Working backwards from that date, allowing time for design, manufacture, erection, and the starting up of equipment, construction charts were prepared covering the items needed.

Three master progress charts covered all these details. These charts were so correlated that work could be started and kept in hand and all sections necessary for the primary start-up would come to completion at the same time.

During the period of construction there were, of course, many slight deviations and adjustments, according to the varying state of the market, which at that time was considerably upset by other war demands. But in general, work followed the charts very closely, with the result that the first production of metal was within 24 hours of the planned date.

The permanent workshops and stores for the plant were built first so as to be available for construction purposes. By this means a great number of smaller items of plant and equipment were fabricated on the spot, thereby tending to reduce the construction time.

In the first few months after the commencement of construction, a few operators and maintenance men were hired and a key group was sent to England for training in operation. These men were put through an intensive course and returned to the plant shortly before it was ready to start up. They hired and trained their own men in such a way that a complete crew was available. They were thus able to take over equipment the moment it passed construction tests. Thus, although there was no similar plant available in the United States, full crews of trained men were ready at the very start of operation.

Their Knowledge Saves Lives

The British Institution of Civil Engineers Has Substantially Assisted the War Effort

By DAVID ANDERSON, M. AM. SOC. C.E.
PRESIDENT OF THE INSTITUTION OF CIVIL ENGINEERS, LONDON, ENGLAND

WITH their nation engaged in a struggle for existence against a persistent aggressor, the professional societies of England have extended every service to their military forces. Among the leaders in this type of cooperation is the Institution of Civil Engineers, which have correlated the activities of its members in solving practical engineering problems engendered by the war and has assembled and furnished to the government needed technical data. Typical of these services have been the authoritative reports which have guided the provision of protective shelters against repeated bombings.

FOUNDING OF INSTITUTION OF CIVIL ENGINEERS

Going back more than a century, it was in the year 1818 that a group of young engineers in Britain resolved to form a society for the mutual exchange of knowledge on engineering matters. Two years later these engineers prevailed upon Thomas Telford, then already famous as a constructor of roads, bridges and canals, to become the first President of the Institution of Civil Engineers, a position he occupied until his death fourteen years later.

As a result of his wise counsel and guidance, the Institution prospered and in 1828 was granted a Royal Charter, its objects being defined as the general advancement of mechanical science and the promotion of the acquisition of that knowledge which constitutes the profession of civil engineering, "the art of directing the great sources of power in Nature for the use and convenience of men."

In directing the policy of the Institution during its early years, Telford was determined that its aim should be the promotion of engineering science rather than the material gain of the individual engineers who formed its membership; and as a result, there was never any question of the organization's becoming merely a debating society. Furthermore, he was insistent that the practical side of engineering should be promoted by the presentation and discussion of papers on actual works, submitted by men of practical experience.

These two salient features in the policy initiated by Telford have been faithfully adhered to, and for more than a hundred years this British Institution has fulfilled the purpose for which it was founded in the following ways:

1. By the publication of its "Minutes of Proceedings" (since 1935 renamed the "Journal"), containing papers and discussions which now form a unique and invaluable record of works of construction carried out in many parts of the world almost since the inception of modern civil engineering.

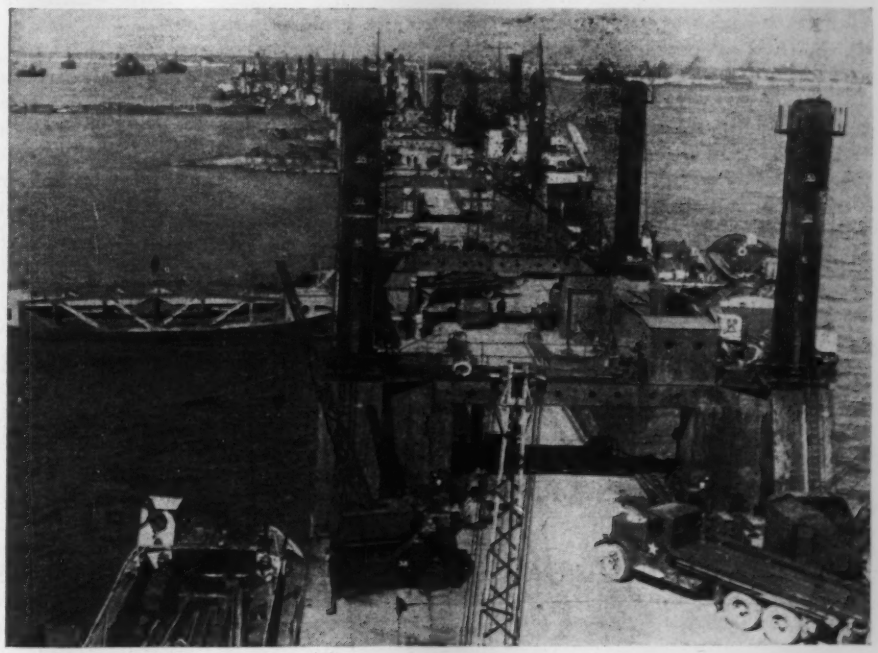
2. By the creation of an engineering library, a collection of which consisted of books, maps, and plans bequeathed by Telford himself, and enriched by donations of members and of various departments of home and foreign governments, in addition to the books acquired by purchase.

3. By laboring consistently to improve the standard of engineering education, thus exercising a dominant influence on both the theoretical and the practical training of engineers. The Institution has always insisted that a sound practical training is an essential part of the education of every engineer, and has rigorously maintained this in laying down the qualifications for those elected to its membership.

The activities of the Institution have also, in recent years, stimulated a number of researches into problems affecting the civil engineer. The roll of the Institution has steadily increased and now numbers 14,340, many of whom are engaged in the practice of engineering in other parts of the world, notably in India and in Britain's colonies.

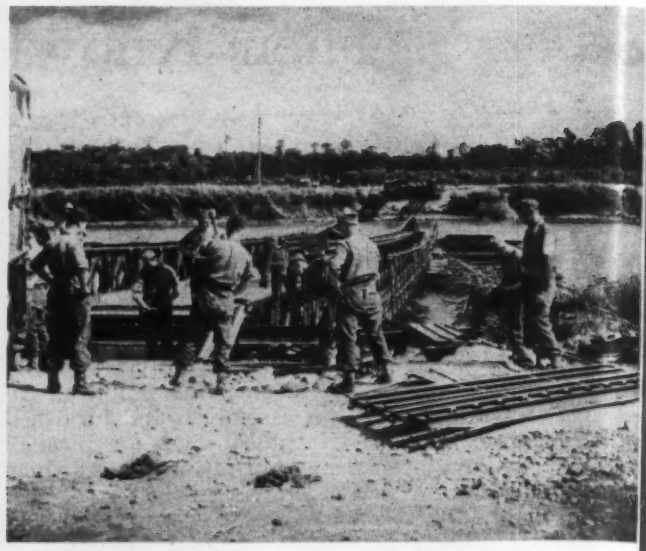
ROLE IN TIME OF WAR

It was at one time to be expected that, in time of war, the Institution's activities would be considerably restricted, since engineering undertakings of a character not directly concerned with military needs for the prosecution of the war would be curtailed or would cease altogether. Modern warfare is synonymous with total war of a character never before visualized. Hence civil defense (the protection of the civil population and particularly of factory workers and others engaged in the making of munitions, from the effects of heavy air bom-



ONE OF THE MOST REMARKABLE ENGINEERING FEATS OF ALL TIME
This Harbor, the Size of Dover, Was Prefabricated in England, Towed Across the Channel to Normandy; It Consists of Seven "Spud Pierheads" Each Displacing a Thousand Tons

Planking Being Placed at Volturno River Crossing, Italy



Work on Approaches to Caen Canal Span, Within Range of Enemy Guns

TWO VIEWS OF BRITAIN'S BAILEY BRIDGE

bardment), and the mobilization of professional and technical personnel for the national effort become matters of great urgency in which the Institution has played an important part.

DESIGN OF PROTECTIVE SHELTERS

In 1938, the Institution, acting with the assurance of the cooperation of the appropriate government department, set up an inquiry to prepare, and provide for engineers, authoritative guidance regarding the protective measures necessary against damage by air bombardment to structures and engineering works from the Luftwaffe. It adopted a program of research as a major part of the experimental and theoretical investigation.

Considerable progress was made, and on the outbreak of war the results were handed over to the government department concerned in order that the work might be carried on with the greater means at the disposal of that department. Furthermore, professional assistance was organized throughout the whole country in connection with the government scheme for air-raid shelters.

In 1941, lectures organized in conjunction with Britain's Institutions of Mechanical and Electrical Engineers, dealing with the effect of high explosives on structures, the design of protective structures and the defense of industry, and a survey of the gas-contamination problem in the engineering industry, with special reference to electrical machinery, were delivered before members of the three institutions.

SUPPLY OF PROFESSIONAL SERVICES

With regard to the need for organizing the services of civil engineers so that they would be used to the best advantage in the national effort, the Institution cooperated with the National Service Department of the Ministry of Labor in the task of compiling a Central Technical Register to be used for supplying (both in Government Service and elsewhere) additional requirements for persons with scientific, technical, professional, and higher administrative qualifications. In the case of younger men, cooperation with the War Office was secured to ensure that they would be given an opportunity to serve in the armed forces in such capacity that their technical qualifications would be of value.

The program of meetings and of papers read and discussed had—for a number of reasons—to be curtailed. Nevertheless certain papers, including those on the repair of war damage to railway and works in the London area, 1940 and 1941, and several dealing with airfield construction, had a direct bearing on the war effort.

The library of the Institution, with its fine record of books and periodicals—particularly those dealing with works of engineering construction carried out in recent years on the European continent—had proved of inestimable value in providing information otherwise unobtainable. The library has now some 66,000 volumes and, by reason of its early founding, contains an accumulation of technical literature and records of inestimable value.

POSTWAR PLANS

The Institution of Civil Engineers has also concerned itself quite recently with questions of postwar reconstruction in Britain. While this has in no way interfered with any activities directly concerned with the prosecution of the war, it was felt that certain investigations might very properly be made in connection with the resumption of construction work either held up or delayed, or with actual reconstruction rendered necessary by enemy action. A report on public works which could be put in hand at the end of the war has been prepared and submitted to various British ministries, with particular stress on the importance of providing facilities for the necessary preliminary planning to enable new works to be commenced without undue delay when hostilities cease.

Finally, the Institution has given very careful consideration to the question of interference with the training of young civil engineers who must enter the armed forces at an early age, and certain relaxations have been obtained to enable such young men to prepare for their future careers before they actually join the British forces. The Institution does not propose to reduce the high standard of qualifications required for such entry. Examinations have been continued and the entrants have included a large number of men in the forees. Arrangements have also been made for examination papers to be placed before men in prisoner-of-war camps.

Changes in Construction Methods and Procedures in Recent Years

By EDWARD W. BUSH, M. AM. SOC. C.E.
ENGINEER, THE AETNA CASUALTY AND SURETY COMPANY, HARTFORD CONN.

POSTWAR contracting methods will continue the tendencies of prewar developments, and highly powered units will speed up future operations. Further, Mr. Bush expects that contractors will group together to bid on large jobs, as such combinations are economical. Large contracts require co-suretyship instead of ordinary bonds. The trend is decidedly in the direction of offering bidders fairly worded contracts and supplying them with full advance information, as determined by preliminary investigations of adequate scope.

THE construction industry, or should I say profession, has certainly shown virility in the past ten or fifteen years. Lots of developments have occurred and it is of interest to discuss some of them. Because the war construction has been under high pressure by methods which will not be used after peace comes, the following comments do not refer to war activities, but to prewar conditions. It is fair to assume that, after the war, prewar conditions will again prevail in the construction industry.

As wages went up, contractors bought equipment which reduced hand labor to a minimum. Some of this new plant was quite expensive, but as it shortened the time factor as well as reduced the amount of labor, contractors continued to buy it. It paid to do so. The manufacturers were constantly putting out bigger and better kinds of plant. While the transition from steam power to gasoline came in a deliberate manner, the later change to diesel-operated equipment came so quickly that one might with propriety call it a jump. I recall inspecting a brand new diesel walking dragline having a 5 or 6-cu yd bucket and a long boom. The contractor paid $170,000 for the machine; but having it led him to win an attractive contract for enlarging a canal at 70 cents per cu yd, while the other low bidders wanted around $1.00 per cu yd, which seemed to be the standard price in the locality for doing similar work with old-fashioned plant and methods.

MANY ADVANCES IN EQUIPMENT

Nearly every piece of modern equipment has its humble prototype. The bulldozer pushes earth around; and so did the split-log drag that was used to fill ruts in the old soft roads. But the bulldozer is also a very handy tractor to push over and tear out small trees or to get behind a big scraper and push when the going gets tough. The modern concrete mixing plant, where all the operations are controlled at a switchboard, is a far cry from the old-style mixer, into which the cement, stone, sand, and water were fed by hand. The vicinity of the old one in dry, windy weather was the dirtiest place on the job, whereas that of the modern one is perhaps the cleanest place, irrespective of weather.

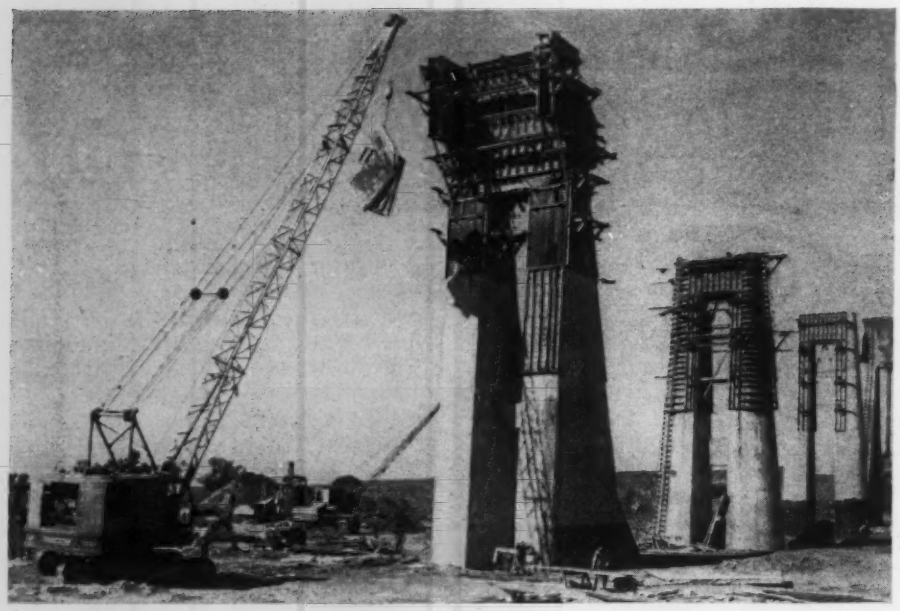
Well-point rigs "make dry ones out of wet ones" and are more convenient to use than the old pumping sumps. Two men operating a small slip scraper drawn by two horses was the rig used for a lot of earth moving when the railroads were being built across the western plains. It would carry from 3 to 6 cu ft, and frequent stops were made to rest the horses. The modern power scraper, having a capacity of about 15 cu yd or more, is operated by one man. Its speed when filling is about 10 to 15 miles per hr, and when going to and from the pit, 20 to 25.

If I had to go to a distant country to do a lot of heavy construction work and could only take one piece of plant with me, I would pick a revolving crane with a long boom mounted on a "cat." With it one can do almost everything—a crane will hold a pile hammer to drive bearing piles or sheet piling; with a clamshell bucket any kind of dry excavation can be done, also many kinds of dredging. It will raise concrete forms after placing mixed concrete in them; it can erect light structural steel and set masonry. It will even pick up a pretty heavy load and move it from here to there. It is a derrick that can operate in many locations in a working day and travel from place to place under its own power. One of the photographs shows a typical installation of six guy derricks used years ago on a masonry bridge contract. At this job a gang of riggers was always taking down or erecting some of the dozen or so derricks. Probably two cranes could have done all that the derricks did.

Those in charge of building good roads during the past fifteen years have never been able to catch up with the demand. The program after the war will be enormous. Ordinary good roads were followed by better ones and they by the super routes, designed for speed and ease of travel, and located to avoid towns and small cities. In some locations a few "super-super" roads were built; probably many others will be started when the war ends.

More and more the highway departments are landscaping these routes with fine plantings of shrubs and trees. Particular attention is paid to the design of the overhead bridges in order to keep the structures in harmony with their surroundings. Appropriate filling stations to the number needed are built by the road departments and then leased to private operators, thus

A BULLDOZER IS A MODERN, GENERAL UTILITY PIECE OF EQUIPMENT



BUILDING HIGH PIERS WITH A REVOLVING CRANE

keeping the control in public hands. Tourists greatly appreciate the numerous parking places located at scenic spots, or perhaps where picnic tables and good drinking water are available.

Auto drivers dislike to cross a body of water by a ferry if there is a suitable bridge nearby. Seldom are the ferries large enough to take care of peak loads without bothersome waits, and often the opening of a drawbridge will cause a traffic jam extending far back. These facts have caused many large highway bridges to be built in recent years. The piers are often located in deep soft bottoms and for them the keenest engineering minds have worked out unique designs. Engineers have used interlocking steel sheet piling freely in their plans for getting down to the hard strata on which the piers will rest; also modern steel H-beams have been used as piling. These beams were first rolled to provide sections which could be used as columns for buildings, and it has only been in recent years that they have been used freely as piling. They will stand a lot of hard driving.

Where foundations are, say, 60 ft deep or more, the trend has been toward open-well dredging for sinking the caissons. Some of these piers have been sunk to depths of 200 ft and more below the water surface. After the soft material is remove from the wells, these are filled i whole or in part with concrete place through a tremie. In recent years have known of but two large bridg contracts in which the compressed- air method was specified for th foundation work, and at one of thes the air method was abandoned an another method adopted which gav a smaller weight per square foot o the bottom. At a third bridge, ai was used after a pier was started b the open-well method. Practicall all the newer highway bridges ove navigable waters are of the high- level type, with sufficient clearanc to permit water traffic to pass under Often this clearance is 200 ft o more. Many large bridges will b built in the postwar period. There is need for them.

One of the outstanding feature of recent construction has been th letting of a large number of big con- tracts for dams and tunnels, fo irrigation, flood control, or power. The top price wa for the Boulder Dam—about $50,000,000. For most o the diversion tunnels, built through the abutments, th contractors have worked out improved ways of per- forming old kinds of work. On the whole the averag unit prices have shown a tendency to go down as th contractors gained from experience.

The Los Angeles Metropolitan Water District built a 240-mile conduit to bring Colorado River water t Southern California; over 90 miles consisted of har rock tunnels. About the time these western contract were finished, the Board of Water Supply of New Yor City started letting about 85 miles of similar water tunne in rock. The work was divided into 16 contracts wit prices running from about $1,700,000 to $21,300,00 each. Naturally, many of the western tunnel contractor moved east with their plants and organizations. On can hardly expect the postwar period to include as muc tunnel work as the period just mentioned.

BIG CONTRACTS TAKEN BY CO-ADVENTURERS

Since about 1930 most of the large contracts, say thos of $5,000,000 or more, have been handled by groups o contractors combining as co-partners or as owners o stock in newly formed corporations. The ful resources of each contractor are general pledged to the undertaking so it is immaterial how the combination is formed. One of th earliest joint ventures of prominence was th Six Companies, Inc., formed to bid on Boulde Dam in March 1931; other notable jobs were the Grand Coulee, Shasta, and Friant dams.

It was not unusual for one large contracting concern to handle several good-sized contract under its own name, at the same time that i was a member of several groups doing othe work. The government wanted bidders o these large jobs, and by forming combination each concern spread its risks and thus wa warranted in assuming more contract obliga tions. The contractors were doing the same thing that the surety companies had been doing for years in co-suretyship or reinsurance. These combinations, of which the writer has a record o

TWO SMALL SLIP SCRAPERS OPERATED BY FOUR HORSES AND FOUR MEN
At One Period This Procedure Was Economical

A Modern Power Scraper at Work—One Man Operates It

more than 120, mostly in the Midwest and on the Pacific Coast, trained the participants in cooperative effort and prepared them to assume the large war construction jobs which they later handled so admirably. We may expect combinations in the future on large jobs, as contractors like to work that way. Two or more experts are better than one either in estimating or constructing a job, also in sharing a loss if that develops.

In practically every case where a group is the contractor, the contract bond is written in the co-surety form. The Treasury of the United States keeps a close checkup of the financial strength of each surety company permitted to bond government contracts and twice a year issues a list of qualified sureties, indicating in the list the maximum bond amount in dollars for which each surety will be acceptable on any one government contract. The amount for which the surety is qualified is generally 10% of its capital and surplus; but rarely indeed would any surety assume a single liability approaching this limit. Formerly it was the custom to reduce a surety's gross amount of any large bond by reinsurance, so that the surety's net retention was well within the amount allowed by the Treasury Department on any one bond; but later the Department instructed the companies to stop this practice and to take care of large cases by issuing bonds in the co-surety form.

CO-SURETYSHIP ON BOULDER DAM

In the main contract for Boulder Dam, the co-suretyship was supplied by 21 companies, each obligated for a definite maximum part. The individual obligations ranged from $550,000 down to $50,000, the aggregate amounting to the $5,000,000 suretyship designated in the setup.

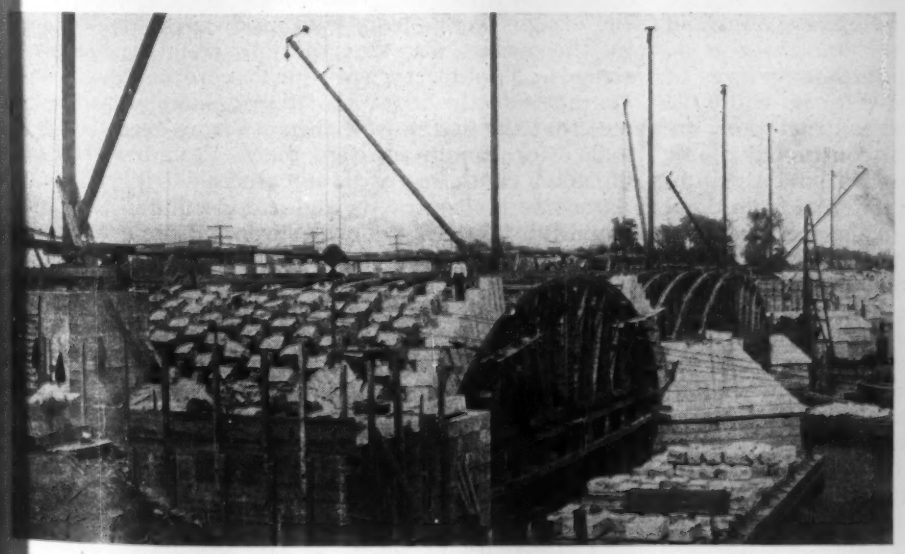
As each surety has a direct obligation to the owner, it might seem that the latter would find co-suretyship a complicated matter. Such is not the case, as the surety that originates the business also arranges the participation of the other sureties, and later acts as the go-between in securing consents for any changes in the contract and for handling claims. Actually, co-surety works as easily as the other kind. The customary obligation is expressed in the bond in regard to each surety participating, in the following wording:

"The principal and the . . . Surety Company, as surety, jointly and severally, in a sum equal to . . . per cent (. . .%) of the total amount of each claim recoverable hereunder, but in no event shall the aggregate liability of the . . . Surety Company exceed the amount of . . . dollars ($. . . .)."

No engineer or public works body desires to let a contract to an unskilled and poorly equipped contractor. Many awarding authorities have adopted some formal or informal way of qualifying contractors either before they are given the plans or before an award is made. The practice is growing and perhaps will become quite general in the near future; it has much to commend it. Since 1933, the U.S. Engineer Corps has included in its Instructions to Bidders the following paragraph—a classic, worthy of inclusion in every construction contract:

"A bid may be rejected if the bidder cannot show that he has the necessary capital and experience, and owns, controls or can procure the necessary plant to commence the work at the time prescribed in the specifications and thereafter to prosecute and complete the work at the rate or time specified; and that he is not already obligated for the performance of other work which would delay the commencement, prosecution or completion of the work contemplated in this advertisement."

In the heyday of high financing, many owners, perhaps I should say promoters, made the contractors the financiers for new hotels or apartments, or for work done for improvement districts. On private work, bond issues had to be sold before cash was available to pay the contractors, and often the latter had to accept all the unsold bonds because there was nothing else. On improvement district work—mostly drainage, pavements, water supply, sewers, or sewage treatment—revenue bonds at times were sold, but very often the contractor had to accept warrants levied against the property benefited. He got these warrants,



Six Guy Derricks on a Masonry Bridge Job

ONE OF THE BETTER ROADS IN CONNECTICUT

say, 60 days after the job was finished, and naturally had to borrow funds with which to prosecute the work.

Often the warrants were discounted much below par, and the property owners thought they were only paying the 5% stated on the face of the warrants, whereas they were in fact paying nearly 20% or more because of the large mark-down demanded by the "note-shaver" who advanced the funds. Probably most postwar contracts will not be started until cash is in sight because contractors know they can get enough thrills out of doing the jobs for the prices bid without adding a lot of worry over revenue bonds or tax warrants. They will probably not bid on the promotion stuff.

THE CONTRACTORS' "MAGNA CHARTA"

Until about 1925 many high-grade contractors would not bid on government work, because most of the contracts were worded so that the contractor, apparently, was liable if anything happened. An interdepartmental committee was set up to work out the terms of a standard contract form giving contractors more consideration, a form under which they would get a square deal if unfavorable conditions developed. After working on the problem for about two years, the final draft of the contract was placed in all governmental construction contracts by the President, November 19, 1926. While the draft has had additions made to it (some of them have been withdrawn later), the first 16 articles have remained substantially as first written.

Contractors especially appreciate certain features of this contract form. Article 3 provides for an equitable adjustment of price if changes in the contract work are ordered, while Article 4 states that the contracting officer shall order changes deemed necessary should the subsurface or latent conditions be found different from those shown on the drawings or indicated in the specifications. Article 9 among other things states that the right of the contractor to proceed shall not be terminated, nor shall liquidated damages be assessed for any delays due to unforeseeable causes beyond the contractor's control.

These articles have been of inestimable value to the construction industry, as they outline a policy of fairness to any contractor who is delayed by causes beyond his control or who has met unexpected foundation conditions. Starting thus with the prestige of the government, this form has acted as a leaven permeating to other owners and their engineers, so that now there are many more fair-minded contract and specification forms than prior to 1926. In fact, fair-mindedness has become so general that when a setup is otherwise, all the prospective bidders note this and govern themselves accordingly.

There has also been a decided improvement in the way the contract specifications and drawings are prepared. Details are concisely set forth. One seldom reads "or as the engineer directs"; the engineer knows what he wants and specifies it. Better investigations of the site are now made. The results are shown in the drawings, and samples of the materials are available to bidders. Through large (36-in.) holes sunk into the foundation rock, the investigator can be lowered on a boatswain's seat and study the actual strata in place. Test pits have been used for years as borrows, but it was left for a vice-president of our Society—Frank E. Winsor—to improve on this method by having steam shovels dig into the borrows, say 50 ft or more. The observer could then see the excavated material as well as the sides of the cut. The method is worthy of universal use.

Perhaps this is too optimistic—but I believe contracts for all important non-federal work in the future will be much better prepared for letting than in the past. The contractor bidders are accustomed to receive detailed information on federal setups and will ask for it on the non-federal work; and the engineers will soon gain the idea that it would be economical to supply it.

RELIEVING CONTRACTORS FROM UNUSUAL HAZARDS

For obvious reasons this is not the place to discuss three hazardous jobs where the engineers attracted bidders by writing specifications so that the owners and not the contractors would carry any flood-damage replacement costs. At each site a flood current might be very swift and of sufficient volume to cause a great amount of damage. In each case the engineer specified how the cofferdams would be built and stated that after they were installed they would be at the risk of the owner. In one case the engineer went further than this and provided replacement costs to the contractor, should a partially installed cofferdam be damaged. Without these special provisions the better class of bidders would have avoided the jobs, or would have bid unreasonably high prices in order to protect themselves. The price bid at each location was considered reasonable.

During recent years I have read more than one contract on risky work in which the owner sought, in a way to make the contractors guarantee the integrity of the designs by specifying that they assume warranties that the designs were adequate to produce the results sought by the owners, also that the jobs could be built as designed. A contractor with such a contract would in fact guarantee to the owner that the engineer was competent and that the design was without errors even though unlooked-for conditions were met. Probably the author of such a clause really did not wish to saddle an unusual hazard on the contractor and had in mind a clause which could fully protect the owner from all the usual hazards of construction.

Owners or contractors now can buy insurance protection from all comprehensive perils on construction operations. More of this will be written in the future. The owner will find such insurance economical, as it will make the work more attractive to bidders and put them all on the same basis. In one recent case, the contractor paid the insurance companies a $36,000 premium for an "all-risk" policy because they thought it was better to part with this money than to carry the risk on the hazardous conditions at the site.

Thanks are extended to the Connecticut Highway Department, the Caterpillar Tractor Company, and R. G. LeTourneau, Inc., for photographs used herein.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

A Calculating-Machine Computation Form for the Three-Point Problem on a Grid

By HOWARD EVES
ASSISTANT PROFESSOR OF MATHEMATICS, SYRACUSE UNIVERSITY, SYRACUSE, N.Y.

THE three-point problem of surveying has been solved by plane-table methods, mechanical methods, trigonometrical methods, graphical methods, and the methods of coordinate geometry. In view of the present trend to compute surveys on the various state plane coordinate systems, and because of the increasing adoption by engineering concerns of calculating-machine procedures to replace the former logarithmic ones, the last-mentioned methods, those of coordinate geometry, are considered the most important. The aim is to construct a computation form yielding the coordinates of the observation station in terms of the two observed angles and the coordinates of the three observed points. The form is to be used in conjunction with a modern calculating machine and is to be as simple, efficient, compact, and self-regulating as possible.

One way of arriving at such a form is to consider a graphical solution of the three-point problem, to convert the steps of the geometrical construction into the processes of analytical geometry, and then to build up the form. Recently the writer carried out this procedure on four selected graphical solutions and arrived at four corresponding computation forms. These forms did not exhibit any very great differences in length or simplicity, as they ranged from one of 40 entries to one of 56 entries, and involved—as might be expected—more or less the same combinations of the given elements.

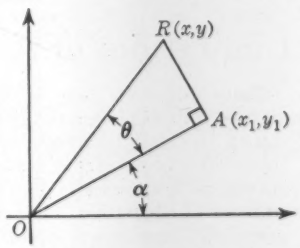


FIG. 2. RELATION OF POINTS AND ANGLES ON COORDINATE AXES

The geometrical construction to be analyzed is here shown in Fig. 1. Let a, b, and c be the map images of three known field points, A, B, and C. Let P be an observation point and let Θ_a and Θ_c be the clockwise angles measured at P from A to B and from B to C, respectively. We wish to find the map image, p, of P.

	$m = \cot\theta_a$	θ_c	$n = \cot\theta_c$
x_A'	y_A'	x_C'	y_C'
$+x_B'$	$-y_B'$	$-x_B'$	$-y_B'$
x_A	y_A	x_C	y_C
$+my_A$	$+mx_A$	$+ny_C$	$-nx_C$
x_E	y_E	x_F	y_F
$-x_F$	$-y_F$	$\frac{DY}{R}$	$-\frac{DX}{R}$
X	Y	$+x_B'$	$+y_B'$
Y^2	x_Fy_E	x_P'	x_P'
X^2	$-x_Ey_F$		
R^2	D		

FIG. 3. COMPUTATION FORM FOR CALCULATING MACHINE

Following the custom in engineering, we take clockwise angles as positive. Draw be' such that $\angle abe' = -(90° - \Theta_a)$ and let be' intersect the perpendicular to ab at a in the point e. Draw bf' such that $\angle cbf' = 90° - \Theta_c$ and let bf' intersect the perpendicular to cb at c in the point f. The sought point p is then the foot of the perpendicular dropped from b on ef. A proof of this construction by elementary geometry may be found on page 354 of *Surveying*, by W. Norman Thomas.

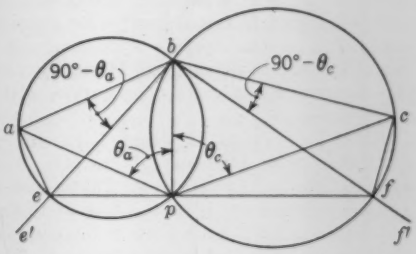


FIG. 1. GEOMETRICAL CONSTRUCTION OF THE THREE-POINT PROBLEM

In the analysis of the preceding construction, we shall need the following:

Lemma: Given point $A(x_1, y_1)$ and the angle Θ. Then the coordinates of the point R such that $\angle ROA = \Theta$ and such that RA is perpendicular to OA are

$$x = x_1 - y_1 \tan\Theta, \qquad y = x_1 \tan\Theta + y_1$$

Let α (Fig. 2) be the clockwise angle at the origin O measured from A to the positive end of the x-axis. Then

$$\begin{aligned} x &= OR\cos(\alpha + \Theta) \\ &= OR(\cos\alpha\cos\Theta - \sin\alpha\sin\Theta) \\ &= (OA/\cos\Theta)[(x_1/OA)\cos\Theta - (y_1/OA)\sin\Theta] \\ &= x_1 - y_1\tan\Theta \end{aligned}$$

Similarly, $y = OR\sin(\alpha + \Theta) = x_1\tan\Theta + y_1$.

THE COMPUTATION FORM

Let the coordinates of A, B, and C be (x_A', y_A'), (x_B', y_B'), and $x_C', y_C')$, respectively. Now translate the axes so that the origin falls on B, and designate the new coordinates of A and C by (x_A, y_A) and (x_C, y_C). Then, by the lemma, the new coordinates of E and F are

$$\begin{aligned} x_E &= x_A - y_A\cot\Theta_a & y_E &= x_A\cot\Theta_a + y_A \\ x_F &= x_C + y_C\cot\Theta_c & y_F &= -x_C\cot\Theta_c + y_C \end{aligned}$$

The equation, in perpendicular form, of the line EF is then

$$\frac{x(y_E - y_F) - y(x_E - x_F) + (x_Ey_F - x_Fy_E)}{\pm[(y_E - y_F)^2 + (x_E - x_F)^2]^{1/2}} = 0$$

The unprimed coordinates of P are now found to be

$$x_P = \frac{(x_Fy_E - x_Ey_F)(y_E - y_F)}{(y_E - y_F)^2 + (x_E - x_F)^2}$$

$$y_P = \frac{(x_Fy_E - x_Ey_F)(x_F - x_E)}{(y_E - y_F)^2 + (x_E - x_F)^2}$$

From these we finally have

$$x_P' = x_P + x_B', \qquad y_P' = y_P + y_B'$$

We may now organize the preceding derivation into the computation form of Fig. 3.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Inter-American Highway Popular in Costa Rica

TO THE EDITOR: I was interested in Mr. Belyea's article, "Commercial Use of Inter-American Highway," in the April issue, and in the subsequent discussion. Although Mr. Belyea's article deals with a project initiated, and now abandoned, by the Army, his comments on the subject of commercial traffic apply equally to the ultimate Inter-American Highway, now under construction by the various republics in cooperation with the U.S. Public Roads Administration.

After four years in Costa Rica, in my connection with the Inter-American Highway, I can say frankly that Mr. Belyea's implication that the highway will be well received by the majority of Latin-Americans is certainly true in the case of Costa Rica.

It is true that there is little or no commercial intercourse between the various Latin-American countries. However, the fact that such intercourse was and, in the case of Costa Rica, still is impossible except by water transportation, has certainly been a contributing factor to the situation. It is a well-known fact that, upon completion of the highway in Costa Rica, commercial intercourse between Panama, Costa Rica, and Nicaragua can and will develop.

As soon as short sections of the highway, in Costa Rica, are opened to traffic, public carriers immediately begin service. Development of lands adjacent to the highway is now evident in areas that were previously isolated.

NORMAN B. WOOD, Assoc. M. Am. Soc. C.E.
Senior Highway Engineer, U.S.
Public Roads Administration

San José, Costa Rica

Forgotten Items of Engineering History

TO THE EDITOR: Unpublished and forgotten instances of engineering history are legion, and it is to be hoped that in time the subject will receive the recognition it deserves—at least to the extent that engineering history will be better recorded and preserved. In the meantime, readers of CIVIL ENGINEERING may be interested in the following items of historical interest culled from a report made by John L. Sullivan, civil engineer of New York and New Jersey, in 1828. This report, which was submitted to the Society for the Establishment of Useful Manufactures, New York and New Jersey, discusses at length the merits of canals and railroads. It is of considerable interest in transportation history to find Mr. Sullivan recommending a system of railways for the northern part of New Jersey, which would connect New York City and New Jersey towns with the mines in the Lackawanna coal fields in Pennsylvania, with branch lines to Trenton and Philadelphia. The system would further provide a connection with New York, Trenton, Philadelphia, and intermediate communities.

Speaking of this proposed railway system, Mr. Sullivan stated: "The railroads thus centering in the capital should be a state work. It would facilitate the trade between the south and the north. But the central communications would not be complete without railways from Trenton to Brunswick, and Amboy. Nor without a line to Camden, whence a line should extend to embrace and accommodate the southwestern counties with cheap access to both New York and Philadelphia. From Camden to Longcoming, thence branching to Hamilton, Millville, and Bridgetown, continuing on to Atsion and sending off a branch to Crocester, and proceeding to Speedwell, Martha, and Tuckerton."

A matter of special historical interest is found in another paragraph, which reads as follows: "Perth Amboy, being always open to navigation, is the most favorable place in New Jersey for a seaport, and the termination of a commercial railroad, because from Brunswick by this route to New York, 33 miles, is the same distance as through Newark; free water carriage is the cheapest conveyance. The continuity of this route for commercial transportation need not be broken, as the railroad carriages will enter upon the Railway Deck of Steam Boats built specially for this purpose, and deliver them into a Railway Warehouse in New York, whence trains of others will be embarked in return, to enter on the road."

It would appear that this is the first reference to a railway car ferry across the Hudson River, or for that matter, the first public statement of the kind.

Another interesting paragraph comments thus: "But New Jersey not only thus offers several of the most profitable lines of railway in the United States, but the United States will be under obligation to one of her sons for an admirable invention in railroad carriages. I speak to Mr. Winans of Sussex, well known for his mechanical ingenuity. . . . . His friction saving railroad carriage will enable a horse to draw 50 tons instead of 10 tons on a level."

While the Ross Winans just referred to made a great contribution to the development of the railway industry of this country, he receives only casual mention, no biography of him ever having been written.

JOHN S. WORLEY, M. Am. Soc. C.E.
Curator and Chairman, Transportation Library, University of Michigan

Ann Arbor, Mich.

Limitations of Area-Moment Formula

DEAR SIR: In Mr. Bregman's article on the area-moment method, in the November issue of CIVIL ENGINEERING, he fails to state a necessary limitation upon the use of the formula he suggests. Unless the beam AB is actually a horizontal member, instead of curved as it appears in Fig. 1, the difference between Δs and Δx will not be negligible. For a sloping beam or a curved beam the proposed formula will be in error to the extent that the sloping length or curved length exceeds the horizontal projection. With moment diagrams of certain shapes this error will be increased.

The formula as stated is correct only for the horizontal beam.

PHIL M. FERGUSON, M. Am. Soc. C.E.
Professor of Civil Engineering
The University of Texas

Austin, Tex.

Reader Comments on the President's Annual Address

TO THE EDITOR: In the President's annual address, published in the September issue of CIVIL ENGINEERING, Mr. Pirnie did well to entitle Proposition 1, "Human Rights." However, his Proposition 2, on the "conservation of rights" seems only remotely connected with the rights set forth in the Declaration of Independence if, indeed, the emphasis is not placed finally on conserving an entirely different set of "rights."

To say the least, it is a bit confusing to read under Proposition 1 that governments are instituted among men "to secure these rights," namely, "life, liberty, and the pursuit of happiness," among others; then under Proposition 2 to find, with Mr. Walter Lippmann, that the State should exist merely to "administer justice among men"; and finally under this proposition to read that certain constitutional checks must be made on agencies established by Congress "to direct details of administration of the collective needs of free enterprise."

It seems to me that Proposition 2 should be related to a more

dynamic phrase than the one quoted from Mr. Lippmann. For a mere continuance of the American way such an aim may be adequate. But major improvements in our way of life, and incidentally the conservation of our constitutional rights, will be attained largely to the extent that we strive for universal realization of those inalienable human rights which we as Americans like to think we already enjoy.

F. D. R. PARK, Jun. Am. Soc. C.E.

Little Rock, Ark.

American Engineers in Spain

TO THE EDITOR: I was much interested in Mr. Kirkpatrick's letter, in the November issue, about John F. Stevens' comments on his trip to Spain for the "rehabilitation" of its railroad system.

This is not quite accurate, for Mr. Stevens' trip was brought about primarily by an investigation by the late J. P. Hallihan, M. Am. Soc. C.E., and myself in the fall of 1910 for MacArthur Brothers, well known railroad contractors, who had been asked to join in the financing and constructing of a railroad from the French frontier at Irun to Madrid and thence to Valencia, about 700 miles in all, for which a concession had been granted to an English syndicate. The proposed line was to be of standard gage (the same as in France) and would be considerably less of a distance to Madrid than the existing wide-gage line. Surveys for the proposed line had been made by competent Spanish engineers, and part of the line had been graded. In company with a partner of Hallgarten & Co., New York brokers, and the London representative of the National City Bank of New York, we made an automobile reconnaissance of the line itself, as well as of a proposed extension to Bilbao. The trip was delightful, and we had full opportunity to see the kind of country traversed by the proposed line.

Although our party did not meet King Alfonso XIII, we met the prime minister and minister of public works, both of whom made favorable impressions. I was particularly impressed with Sr. Canalejas, the prime minister, who was broad-minded enough to say (twelve years after our Spanish War) that, because of the wonderful improvements we had made in Puerto Rico and the Philippines, he desired to have American engineers and contractors construct railroads and other public works in Spain.

On our report that the project was worth serious consideration, Mr. Stevens accompanied a vice-president of the National City Bank to make a further investigation. Although I understood at the time that Mr. Stevens made a favorable report from the engineering points of view the bond market situation was not so clear, and the railroad was never built.

Although I did not meet the king, I saw him several times on the street where he was walking most informally with youthful companions (he was then 24 years of age) without any guards in sight, as far as one could see. Mr. Hallihan and I attended a bull fight at San Sebastian, at which both the king and queen were present. This must have been before Queen Victoria had the special opera glasses described by Mr. Stevens, for she seldom looked in the direction of the bull, but was engaged in animated conversation with those about her.

It is not surprising that the king, at his age, took little interest in railroad development as noted by Mr. Stevens, for he had an unusually competent prime minister, who was assassinated a year later—a great calamity for Spain, I have always thought. At that time the king was very popular on account of his youth, his geniality, and for the coolness he had displayed four years previously when a bomb was thrown at the carriage containing the king and his bride at the time of their wedding. Although several people were killed and wounded, the royal couple escaped injury.

PHILIP W. HENRY, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

German Construction Cranes in Service at Canal Zone

TO THE EDITOR: For the past three decades, two stalwart natives of Germany have done strong-backed work for America along the Canal Zone's waterfronts amid world shipping. Now they show some deterioration from the tropical climate, and are being Americanized in a material sense of the word. They have earned that right. And it is pleasant to think so as one sees them hereafter continue to help shipping that's in trouble.

The story of the Panama Canal's 250-ton giant floating cranes Ajax and Hercules is unique. In happier days of international comity and business the Deutsche Maschinen Fabrick, A.G., of Duisburg, Germany, underbid her nearest low American rival about 40%. The contract was for the design, fabrication and erection of both cranes. The pontoons and superstructures were shipped separately and assembled at Gatun, using the upper lock as a drydock. In the acceptance tests, at underload, the Ajax's jib failed and smashed on the lockwall, killing or injuring several men.

The contract was disastrous to the contractor. His low bid was possible mostly because of a secret alloy in the main members of his crane. Presumably the members were designed to take unusually high unit stresses, and certain loadings were guaranteed. Engineers for the canal redesigned the weak parts along more conventional lines, and the new jib and materials for strengthening both cranes had to come from Germany. In the meantime, the first World War had started. However, when the material for repairs was shipped from Rotterdam in 1915, it was allowed, by special arrangement of our State Department, to go unhampered through the English blockade to the Canal Zone. Since then the cranes have had a useful and usually less eventful time.

Not always however have they had uninteresting work. On November 28, 1923, the Navy Submarine O-5 sank in 45 ft of water in a collision in Cristobal Harbor, with a loss of three lives and two crew members imprisoned below. Within two days the Ajax and Hercules, dispatched to the scene from 40 miles away, had raised one end of the sub so that the imprisoned crew members got out.

The work now being done consists largely of the redrafting of all the cranes' plans and curves into English (the German employed in the original plans and the use of the metric system have been a nuisance in making spare parts, as of course parts cannot be purchased); complete modernizing of the switchboards and new wiring for the extensive power-control and lighting circuits; and slight renewals of mechanical, hull, and structural parts.

RALPH Z. KIRKPATRICK

Rochester, N.Y.

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

Herewith Dr. Mead gives his answer to Question No. 28, which was announced in the November issue of "Civil Engineering." The question reads as follows: "Bids for some paving were received by the city council in a small city. Among these was a bid from a contractor, who was a personal friend of many of the aldermen. The contractor's bid was as low as any other presented. Is the council warranted in awarding the work to this contractor, if it is satisfied with his experience along the line in question?"

The better a contractor is known to a city council or its engineer, the better that council is able to know whether or not he is capable and reliable and should or should not be awarded a contract.

The writer has always endeavored to eliminate his personal feelings in such matters and has actually recommended the award of a contract to a contractor in cases where he felt the contractor was entitled to the award, even though he would not have dealt with the contractor himself because of a personal dislike for him.

DANIEL W. MEAD, Past-President
and Hon. M. Am. Soc. C.E.

Madison, Wis.

Question No. 29, which was announced in the December issue, will be answered in the forthcoming, or February, issue. Next in the series, the following question is announced. Replies may be received until February 5, with answers in the March issue.

QUESTION NO. 30: *An engineer was employed to design and supervise the construction of a plant. While the construction was in progress he made suggestions to the contractor regarding his methods employed, with the result that the contractor received a larger profit. After final payments had been made to the contractor and engineer, the contractor offered the engineer a reward for his suggestions. Should the engineer accept or reject?*

Ninety-Second Annual Meeting

Commodore Hotel, New York, N.Y., January 17–19, 1945

Business Meeting, Prize Awards, Conferring of Honorary Memberships, and Presentation of John Fritz Medal

WEDNESDAY—January 17, 1945—Morning

Grand Ballroom

9:00 Registration in the Grand Ballroom Foyer

10:00 Ninety-Second Annual Meeting called to order by

MALCOLM PIRNIE, *President, American Society of Civil Engineers*

Report of the Board of Direction

Report of the Secretary

Report of the Treasurer

10:30 Presentation of Society Medals and Prizes

The Norman Medal to RALPH B. PECK, *Jun. Am. Soc. C.E., Research Assistant Professor, Soil Mechanics, University of Illinois*, Urbana, Ill., for Paper No. 2200, "Earth-Pressure Measurements in Open Cuts, Chicago (Ill.) Subway."

The J. James R. Croes Medal to NATHAN M. NEWMARK, *Assoc. M. Am. Soc. C.E., Research Professor, Civil Engineering, University of Illinois*, Urbana, Ill., for Paper No. 2202, "Numerical Procedure for Computing Deflections, Moments, and Buckling Loads."

The Thomas Fitch Rowland Prize to EUGENE L. GRANT, *M. Am. Soc. C.E., Professor of Economics of Engineering, Stanford University*, Stanford University, Calif., for Paper No. 2203, "Fundamental Aspects of the Depreciation Problem—Relationship to Competitive Industry."

The James Laurie Prize to GORDON R. WILLIAMS, *Assoc. M. Am. Soc. C.E., Senior Hydraulic Engineer, Civil Works Division, Office of the Chief of Engineers*, Washington, D.C., for Paper No. 2173, "Drainage of Leveed Areas in Mountainous Valleys."

The Collingwood Prize for Juniors to WALTER L. MOORE, *Jun. Am. Soc. C.E., Senior Research Engineer, Lockheed Aircraft Corporation*, Burbank, Calif., for Paper No. 2204, "Energy Loss at the Base of a Free Overfall."

The J. C. Stevens Award to BORIS A. BAKHMETEFF, *M. Am. Soc. C.E., Professor, Civil Engineering, Columbia, University*, New York, N.Y., and NICHOLAS V. FEODOROFF, *Assoc. M. Am. Soc. C.E., Research Associate, Civil Engineering, Columbia University*, New York, N.Y., for their discussion of Paper No. 2186, "Profile Curves for Open-Channel Flow."

The Construction Engineering Prize to FRED W. STIEFEL, *Assoc. M. Am. Soc. C.E., President, Stiefel Construction Corporation*, New York, N.Y., for paper appearing in April 1944 issue of CIVIL ENGINEERING entitled, "Inclined Mine Shaft Sunk in the Adirondacks."

11:00 Conferring of Honorary Membership

ARTHUR J. DYER, *Hon. M. Am. Soc. C.E., Chairman of Board, Nashville Bridge Company*, Nashville, Tenn.

Mr. Dyer will be presented to the President by EZRA B. WHITMAN, *Past-President, Am. Soc. C.E., Whitman, Requardt and Associates*, Baltimore, Md.

CHARLES P. GROSS, *Hon. M. Am. Soc. C.E., Major General, Corps of Engineers, U.S.A.*, Fort Myer, Va.

General Gross will be presented to the President by RICHARD E. DOUGHERTY, *Vice-President, Am. Soc. C.E., Vice-President, Improvements and Development, New York Central Railroad*, New York, N.Y.

HORACE W. KING, *Hon. M. Am. Soc. C.E., Professor Emeritus*, Ann Arbor, Mich.

Mr. King will be presented to the President by CHESTER O. WISLER, *M. Am. Soc. C.E., Professor, Hydraulic Engineering, University of Michigan*, Ann Arbor, Mich.

LOUIS C. SABIN, *Hon. M. Am. Soc. C.E., Vice-President, Lake Carriers' Association*, Cleveland, Ohio

Mr. Sabin will be introduced to the President by GEORGE H. FENKELL, *Hon. M. Am. Soc. C.E., Consulting Engineer*, Almont, Mich.

ARTHUR SURVEYER, *Hon. M. Am. Soc. C.E., Consulting Engineer, Arthur Surveyer and Company*, Montreal, Que., Canada

Mr. Surveyer will be introduced to the President by JOHN B. CHALLIES, *M. Am. Soc. C.E., Vice-President, Shawinigan Water and Power Company, Ltd.*, Montreal, Que., Canada

11:30 Presentation of John Fritz Medal to

JOHN L. SAVAGE, *Hon. M. Am. Soc. C.E., Consulting Engineer, Tennessee Valley Authority; Chief Designing Engineer, U.S. Bureau of Reclamation*, Denver, Colo.

Introduction of EZRA B. WHITMAN, *Past-President, Am. Soc. C.E., Chairman, John Fritz Medal Board of Award*

Statement by Chairman Whitman on history and purpose of the Medal. Address on achievements of the medalist by W. F. DURAND, *Chairman, Division of Engineering and Industrial Research, National Research Council*, Washington, D.C.

Presentation of the John Fritz Medal to John L. Savage by JAMES W. PARKER, *Past-President, American Society of Mechanical Engineers, and Chairman of the John Fritz Medal Board* that made the award.

Because of his absence from the United States, Mr. Savage will be represented by his sister, Mrs. Mary Winston of Denver, Colo.

12:00 New Business

Report of Tellers on Canvass of Ballots for Officers

Introduction of President-Elect and New Officers

12:30 Adjournment for Luncheon

Wednesday Luncheon—Grand Ballroom, 12:45 p.m.

At the close of the Wednesday morning session there will be a luncheon for members, guests and ladies in the Grand Ballroom, Hotel Commodore.

Mr. G. Donald Kennedy

Chairman, Society's Committee on Postwar Construction and Vice-President, Automotive Safety Foundation, Washington, D.C., will address the luncheon group on

"POSTWAR CONSTRUCTION: THE JOB IS YOURS"

Mr. Kennedy will be introduced by MALCOLM PIRNIE, *President, American Society of Civil Engineers and Chairman, Action and Advisory Committee for Committee on Economic Development.*

Ladies are cordially invited to this luncheon with members and guests.

Tickets: $2.00 for Members and Ladies; $2.50 for non-members; $1.00 for students.

Sessions of Technical Divisions—Wednesday Afternoon

CONSTRUCTION DIVISION

West Ballroom

This session will be devoted to discussions regarding the need for a standard form of contract and specifications for construction

ADOLPH J. ACKERMAN, *Chairman, Executive Committee, Construction Division, Presiding*

2:30 **Introductory remarks**

ADOLPH J. ACKERMAN, *M. Am. Soc. C.E., Director of Engineering, Dravo Corporation*, Pittsburgh, Pa.

2:45 **Fundamental Principles of Specifications**

ROGER W. ARMSTRONG, *M. Am. Soc. C.E., Deputy Chief Engineer, Board of Water Supply*, New York, N.Y.

3:15 **Construction Specifications and Contracts**

ROLF T. RETZ, *Assoc. M. Am. Soc. C.E., Civil Engineer, National Advisory Committee for Aeronautics*, Langley Field, Va.

3:45 **General discussion**

Engineers and contractors are urged to present brief discussions, and preferably file with the Chairman written memoranda, for developing approved forms of contracts and specifications, and for standardization under the sponsorship of the Society.

5:00 **Adjournment**

SANITARY ENGINEERING DIVISION

East Ballroom

R. F. GOUDEY, *Chairman, Executive Committee, Sanitary Engineering Division, Presiding*

2:30 **Introductory remarks**

R. F. GOUDEY, *M. Am. Soc. C.E., Sanitary Engineer, Bureau of Water Works and Supply*, Los Angeles, Calif.

2:35 **Report of the Committee on Organization, Financing and Administration of Sanitary Districts**

SAMUEL A. GREELEY, *M. Am. Soc. C.E., Consulting Engineer, Greeley and Hansen*, Chicago, Ill.

3:05 **Discussion**

3:20 **Report of the Committee on Evaluation of Professional Objectives in the Design of Sanitary Engineering Works**

THOMAS R. CAMP, *M. Am. Soc. C.E., Consulting Engineer*, Boston, Mass.

3:50 **Discussion**

4:30 **Report of the Committee on Water Supply Engineering**

THOMAS H. WIGGIN, *M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y.

5:00 **Discussion**

5:30 **Adjournment**

SURVEYING AND MAPPING DIVISION

Rooms B and C

PHILIP KISSAM, *Chairman, Executive Committee, Surveying and Mapping Division, Presiding*

2:30 **Introductory remarks**

PHILIP KISSAM, *M. Am. Soc. C.E., Associate Professor, Civil Engineering, Princeton University*, Princeton, N.J.

2:40 **Aerial and Ground Surveys and Related Land Development**

WILBUR H. SIMONSON, *M. Am. Soc. C.E., Principal Landscape Architect, Public Roads Administration*, Washington, D.C.

3:20 **Discussion by**

WILLIAM N. BROWN, *M. Am. Soc. C.E., President, W. N. Brown, Inc.*, Washington, D.C.

3:30 **General discussion**

3:40 **The Importance of Experience in Land Surveying**

BENJAMIN A. SLEEPER, *Assoc. M. Am. Soc. C.E., Civil Engineer, Sherman and Sleeper*, Camden, N.J.

4:20 **Discussion by**

JOHN S. DODDS, *M. Am. Soc. C.E., Professor, Civil Engineering, Iowa State College*, Ames, Iowa

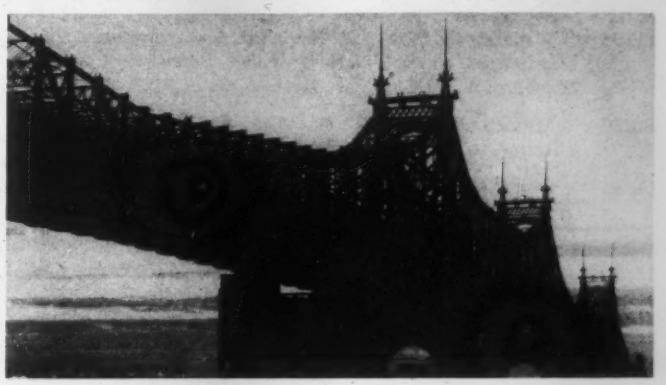
4:30 **General discussion**

4:40 **Report on the Second Pan American Consultation on Geography and Cartography**

ROBERT H. RANDALL, *M. Am. Soc. C.E., President, Commission on Cartography of the Pan American Institute of Geography and History; and Vice-President of the Consultation; Chief Examiner, U.S. Bureau of the Budget*, Washington, D.C.

5:20 **General discussion**

5:30 **Adjournment**



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QUEENSBORO BRIDGE OVER EAST RIVER, NEW YORK

Dinner, Reception and Dance

WEDNESDAY—January 17, 1945—Evening

Grand Ballroom—Commodore Hotel

Committee: L. S. WATERBURY, *Chairman;* CARL H. GRONQUIST, M. N. QUADE

7:00 Assembly

7:45 Dinner

9:30 Reception to the President and Honorary Members

10:00 Dancing

Dinner will be served promptly at 7:45 p.m.

Arrangements have been made for tables seating ten persons, and members may underwrite complete tables. Orders to underwrite a table must be accompanied by check in full and a list of guests.

Tickets will be $6.00 each. Tickets for Juniors, for the dance only, will be $2.00 per couple.

The seating list for the Dinner-Dance will close at 5:00 p.m., Tuesday, January 16, 1945. Those who purchase tickets after that hour will be assigned to tables in the order of purchase. Tickets will be on sale at Society Headquarters until 5:00 p.m., Wednesday, January 17, 1945.

Sessions of Technical Divisions—Thursday Morning

JOINT SESSION—HYDRAULICS AND WATERWAYS DIVISIONS

Rooms B and C

BORIS A. BAKHMETEFF, *Chairman, Executive Committee, Hydraulics Division, Presiding*

9:30 Introductory remarks

BORIS A. BAKHMETEFF, *M. Am. Soc. C.E., Professor, Civil Engineering, Columbia University,* New York, N.Y.

CHARLES L. HALL, *M. Am. Soc. C.E., Colonel, Corps of Engineers, U.S.A.,* Columbus, Ohio

SYMPOSIUM ON FLOOD FLOWS AND FLOOD REGULATION—SESSION I

Program arranged by Joint Program Committee of Hydraulics and Waterways Divisions

9:45 Climatic Variations of Postglacial Time as Related to Floods and Droughts (Abstract)

FRANÇOIS E. MATTHES, *Assoc. M. Am. Soc. C.E., Senior Geologist, U.S. Geological Survey,* Washington, D.C.

10:10 Discussion by

ADOLPH F. MEYER, *M. Am. Soc. C.E., Consulting Hydraulic Engineer,* Minneapolis, Minn.

10:25 Limitations in the Accuracy of Flood Studies, Introductory Outline

WILLIAM P. CREAGER, *M. Am. Soc. C.E., Consulting Engineer,* Buffalo, N.Y.

Discussion by

11:05 WILLIAM G. HOYT, *M. Am. Soc. C.E., Executive Officer, Department of the Interior, Water Resources Committee,* Washington, D.C.

11:20 MERRILL BERNARD, *M. Am. Soc. C.E., Hydrologic Director, U.S. Weather Bureau,* Washington, D.C.

11:35 GORDON L. WILLIAMS, *Assoc. M. Am. Soc. C.E., Senior Hydraulic Engineer, Civil Works Division, Office of the Chief of Engineers,* Washington, D.C.

11:50 EMIL P. SCHULEEN, *Assoc. M. Am. Soc. C.E., Senior Engineer, U.S. Engineer Office,* Pittsburgh, Pa.

12:05 L. K. SHERMAN, *M. Am. Soc. C.E., Consulting Engineer,* Chicago, Ill.

12:20 General discussion

12:45 Adjournment

SANITARY ENGINEERING DIVISION

Grand Ballroom

R. F. GOUDEY, *Chairman, Executive Committee, Sanitary Engineering Division, Presiding*

9:30 Depletion and Recharge of Ground Water Supplies

CHARLES L. MCGUINNESS, *Groundwater Division, U.S. Geological Survey,* Washington, D.C.

10:10 Discussion

10:20 Postwar Planning in the Sanitary Engineering Field

E. SHERMAN CHASE, *M. Am. Soc. C.E., Consulting Engineer, Metcalf and Eddy,* Boston, Mass.

11:00 Discussion

11:20 Water Supply on the Battle Front

WILLIAM H. SMITH, *M. Am. Soc. C.E., Captain (CEC), U.S.N., Bureau of Yards and Docks,* Washington, D.C.

11:50 Discussion

12:00 Adjournment

STRUCTURAL DIVISION

West Ballroom

CHARLES A. ELLIS, *Chairman, Executive Committee, Structural Division, Presiding*

9:30 Introductory remarks

CHARLES A. ELLIS, *M. Am. Soc. C.E., Professor, Structural Engineering, Purdue University,* West Lafayette, Ind.

SYMPOSIUM ON THE BROOKLYN BRIDGE

9:33 Historical Background and Features of Construction and Operation

HOMER R. SEELY, *M. Am. Soc. C.E., Deputy Commissioner, Department of Public Works,* New York, N.Y.

10:03 Design and Stress Condition

O. H. AMMANN, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y.

10:43 Physical Examination and Field Observations

NOMER GRAY, *Assoc. M. Am. Soc. C.E., Civil Engineer, Department of Public Works,* New York, N.Y.

11:13 Test of Materials in Cables and Stiffening Trusses

HAROLD E. WESSMAN, *M. Am. Soc. C.E., Chairman, Department of Civil Engineering, Professor, Structural Engineering, New York University,* New York, N.Y.

11:33 Discussion

12:15 Adjournment

Sessions of Technical Divisions—Thursday Afternoon

JOINT SESSION—HYDRAULICS AND WATERWAYS DIVISIONS

Rooms B and C

CHARLES L. HALL, *Member, Executive Committee, Waterways Division, Presiding*

SYMPOSIUM ON FLOOD FLOWS AND FLOOD REGULATION—SESSION II

Program arranged by Joint Program Committee of Hydraulics and Waterways Divisions

2:00 **Operation of Multiple-Purpose Reservoirs on the Tennessee River System**

CLARENCE E. BLEE, *M. Am. Soc. C.E., Chief Engineer, Tennessee Valley Authority*, Knoxville, Tenn.

2:45 **Discussion by**

E. H. SARGENT, *Chief Engineer, Hudson River Regulating District*, Albany, N.Y.

3:00 **Flood Control in an Industrialized Valley**

CHARLES L. HALL, *M. Am. Soc. C.E., Colonel, Corps of Engineers*, Columbus, Ohio

Discussion by

3:45 CHARLES M. WELLONS, *M. Am. Soc. C.E., Lt. Col., Corps of Engineers*, Pittsburgh, Pa.

4:00 EMIL P. SCHULEEN, *Assoc. M. Am. Soc. C.E., Senior Engineer, U.S. Engineer Office*, Pittsburgh, Pa.

4:15 **General discussion**

5:00 **Adjournment**

HIGHWAY DIVISION

West Ballroom

ROGER L. MORRISON, *Chairman, Executive Committee, Highway Division, Presiding*

2:00 **Introductory remarks**

ROGER L. MORRISON, *M. Am. Soc. C.E., Professor, Highway Engineering and Highway Transportation, University of Michigan*, Ann Arbor, Mich.

2:10 **Postwar Highway Planning**

HAL H. HALE, *M. Am. Soc. C.E., Executive Secretary, American Association of State Highway Officials*, Washington, D.C.

2:50 **Discussion**

3:10 **Express Highway Planning for Metropolitan Areas**

JOSEPH BARNETT, *M. Am. Soc. C.E., Chief, Urban Road Division, U.S. Public Roads Administration, Federal Works Agency*, Washington, D.C.

Discussion by

3:50 HARRY W. LOCHNER, *M. Am. Soc. C.E., Manager, H. W. Lochner and Co.*, Chicago, Ill.

4:10 LAWRENCE S. WATERBURY, *M. Am. Soc. C.E., Associate Engineer, Parsons, Brinckerhoff, Hogan and Macdonald*, New York, N.Y.

4:30 **General discussion**

5:00 **Adjournment**

SANITARY ENGINEERING DIVISION

Grand Ballroom

R. F. GOUDEY, *Chairman, Executive Committee, Sanitary Engineering Division, Presiding*

2:00 **Evaluation of Sewage Works Data**

WILLIAM L. HAVENS, *M. Am. Soc. C.E., Consulting Engineer, Havens and Emerson*, Cleveland, Ohio, and

FRANK W. JONES, *M. Am. Soc. C.E., Consulting Engineer, Havens and Emerson*, Cleveland, Ohio

2:40 **Discussion**

2:50 **Characteristics and Disposal of Trade Wastes from the Copolymer Synthetic Rubber Industry**

GEORGE E. BARNES, *M. Am. Soc. C.E., Head, Department of Civil Engineering, and Professor, Hydraulic and Sanitary Engineering, Case School of Applied Science*, Cleveland, Ohio, and

MATHEW M. BRAIDECH, *Professor, Sanitary and Industrial Chemistry, Case School of Applied Science*, Cleveland, Ohio

3:30 **Discussion**

3:40 **The Future of American Engineers in Latin America**

JOHN P. HOGAN, *Past-President, Am. Soc. C.E., Consulting Engineer, Parsons, Brinckerhoff, Hogan and Macdonald*, New York, N.Y.

4:20 **Discussion**

4:30 **Adjournment**

Dinner-Smoker for the Men

Grand Ballroom—Commodore Hotel

THURSDAY—January 18, 1945—Evening

Committee: JAMES H. GRIFFIN, *Chairman;* A. K. BURNHAM, CHILTON A. WRIGHT

6:30 **Dinner**

8:30 **Entertainment**

The Annual Dinner-Smoker will be held on Thursday evening in the Grand Ballroom of the Commodore Hotel. Dinner will be served promptly at 6:30 p.m. and will be followed at 8:30 p.m. by an interesting program of entertainment.

At the 1945 Annual Meeting, several college reunion dinners will be held at the Commodore on the same night as the Dinner-Smoker, these groups to join the main group for the entertainment at 8:30 p.m. Regular Dinner-Smoker tickets may be purchased for these reunion dinners, detailed notices of which appear elsewhere in this program.

Members' tickets, $2.50.

Guest tickets, $3.50.

Ladies' tickets.—Because of the anticipated interest of the ladies in the entertainment to be provided at the Dinner-Smoker this year, ladies will be admitted for the entertainment to begin at 8:30 p.m. A special ticket will be given free of charge to those members accompanied by ladies, as indicated on the registration card. These tickets are to be presented at the balcony of the Ballroom at the Commodore between 8:15 p.m. and 8:30 p.m.

Ladies' Entertainment Features for Thursday

THURSDAY—January 18, 1945—Afternoon and Evening

2:00 Motion Picture Entertainment

The ladies are invited to attend the showing of two motion pictures not previously shown publicly, entitled "Americans All" and "Movies March On," and a revival of "The Tramp" featuring Charlie Chaplin. The presentation will take place in the Auditorium of the Engineering Societies Building, 33 West 39th St. Admission is free and no reservations are necessary. The showing will begin promptly at 2:15 p.m. and will last about one hour.

The Commodore Hotel is located on 42nd St., just east of the Grand Central Terminal, and about a ten-minute walk from the Engineering Societies Building. Arrangements have been made with one of the taxicab companies to have several cabs cruise past the building from 3:15 to 3:45 p.m. for those who desire taxi service returning to the Commodore.

3:30 Tea and Talk on "Coordinating Your Wardrobe"

The East Ballroom of the Commodore has been reserved for the ladies from 3 to 7 p.m. on Thursday, January 18th. It is suggested that the ladies plan to arrive at about 3:30 as tea will be served promptly at 4 p.m.

ELEANOR NASH, lecturer, clothes adviser, and author of *Footnote to Life*, will entertain with a talk on "Clothes Sense and Common Sense," through the courtesy of Bonwit Teller, Inc., specialty shop for women's apparel. Tickets for the tea and talk are $1.00.

8:30 Entertainment at Dinner-Smoker

Although the Annual Dinner-Smoker is strictly a stag affair, arrangements are being made to reserve seats for ladies in the Balcony of the Grand Ballroom of the Commodore for the entertainment features of the Smoker, beginning at 8:30 p.m. Tickets to the ladies for the evening's entertainment are free and may be obtained at the Registration Desk. Ladies who attend should arrive promptly and be seated by 8:25 p.m.

During the three days of the Annual Meeting, trips for ladies to places of special interest in New York will be organized as desired. As a suggestion various places are listed below. No special transportation can be provided.

Note: Room F on the Ballroom Floor will be reserved throughout the meeting as a headquarters for the ladies.

Trips to Places of Special Interest in New York

N.Y. Herald Tribune Home Institute

A special courtesy has been extended to visit the Home Economics Department at 230 West 41st St., at 10:30 a.m., Friday, January 19. The tour will be personally conducted and will last about one hour and a half. Limited to 100 ladies.

Empire State Building Observation Tower

The Empire State Building is at 34th St. and 5th Ave. The Tower is open from 8:30 a.m. to 12:30 a.m. The charge is $1.20 per person.

Rockefeller Center

Rockefeller Center, between 5th and 6th Aves. and 48th and 51st Sts., contains several places of interest for which regular guided tours are available. Among them is the N.B.C. Studio—Television Tour, which takes groups actually behind the scenes of radio broadcasting and television. Groups for this tour leave the Studio Section of the R.C.A. Building every twenty minutes from 9 a.m. to 11 p.m. every day, the tour taking one hour and the charge being 60 cents per person, or 45 cents per person for groups of 10 or more. Tickets at the 45-cent rate may be arranged for through the Society, whether by groups or individually.

The Museum of Modern Art

The Museum of Modern Art is at 11 West 53rd St., just west of 5th Ave. The regular admission charge is 30 cents. Starting promptly at 2 p.m. on Friday, January 19th, a gallery talk and guided tour of the museum has been arranged. The regular film showings are at 3 and 5:30 p.m. On Wednesday and Thursday, January 17th and 18th, three films, "A Corner in Wheat" (1909), "New York Hat" (1912), and "A Fool There Was" (1914), will be shown as a part of "The Rise of the American Film." On Friday, January 19th, the film is "Great Actresses of the Past," which includes "Madame Sans-Gene," "La Dame aux Camelias," "Vanity Fair," and "Cenere."

Metropolitan Museum of Art

The Metropolitan Museum of Art provides a daily program of educational lectures. Special exhibitions through January include 16th Century French prints, European textiles, and Greek paintings. The paintings, which were stored for safe keeping during the emergency have been returned and are now installed in galleries (on the second floor) redecorated and rearranged to receive them. Admission to the museum is free. The museum restaurant serves luncheon until 3 p.m. The museum, which is at 82nd and 5th Ave., may be reached by 5th Ave. buses Nos. 2, 3, or 4.

The Frick Collection

The Frick museum includes masterpieces by old and newer painters, rich furnishings, etc., and is on exhibition at 1 East 70th St., just east of 5th Ave., reached by 5th Ave. buses Nos. 2, 3, or 4. Organ recitals are given at 11 a.m., 1:30 and 4 p.m., and there is a regular lecture at 3 p.m. each Wednesday through Saturday. Admission is free.

Museum of the City of New York

The Museum of the City of New York is a historical museum of the City. Of special interest to ladies would be the exhibits of costumes, interior furnishings, toy shop, and silverware. A specially conducted tour can be arranged for a group of ladies for a morning or afternoon. The Museum is at 5th Ave. and 104th St., and is reached by 5th Ave. buses Nos. 2, 3, or 4.

Cathedral of St. John the Divine

The Cathedral of St. John the Divine is at Amsterdam Ave. between 110th and 113th Sts. The Cathedral, which is still under construction—the cornerstone having been laid in 1892—when completed will be the largest Gothic cathedral in the world. It is open to visitors from 8 a.m. to 6 p.m., guided tours being conducted at 11 a.m., 12 noon, 2, 3, and 4 p.m. daily except Mondays. Visitors should enter by the 112th St. entrance, as the tours start from the exhibit hall. The cathedral is reached by 5th Ave. bus No. 4 or by 8th Ave. subway and buses at 110th St., and by Broadway surface car or subway (1 block west at 110th St.).

St. Patrick's Cathedral

St. Patrick's Cathedral, located on 5th Ave. between 50th and 51st Sts., is open to visitors from 6 a.m. to 9:30 p.m.

Sessions of Technical Divisions—All Day Friday

JOINT SESSION—HYDRAULICS AND WATERWAYS DIVISIONS

Rooms B and C

WILLIAM G. HOYT, *Member, Executive Committee, Hydraulics Division, Presiding*

SYMPOSIUM ON FLOOD FLOWS AND FLOOD REGULATION—SESSION III

Program arranged by Joint Program Committee of Hydraulics and Waterways Divisions

9:30 **Operation and Effect of Reservoirs in the Pittsburgh Flood Control System**

EMIL P. SCHULEEN, *Assoc. M. Am. Soc. C.E., Senior Engineer, U.S. Engineer Office*, Pittsburgh, Pa.

10:15 **Discussion by**

CHARLES M. WELLONS, *M. Am. Soc. C.E., Lt. Col., Corps of Engineers*, Pittsburgh, Pa.

GAIL A. HATHAWAY, *Director, Am. Soc. C.E., Head Engineer, Corps of Engineers, Office, Chief of Engineers*, Washington, D.C.

10:45 **Model Experiments as an Aid in Solving Johnstown's Flood Control Problem**

JOSEPH B. TIFFANY, JR., *Assoc. M. Am. Soc. C.E., Captain, Corps of Engineers, Executive Assistant to the Director, U.S. Waterways Experiment Station*, Vicksburg, Miss.

11:30 **Discussion by**

JOHN C. HARROLD, *Assoc. M. Am. Soc. C.E., Engineer, Office of Chief of Engineers, War Department*, Washington, D.C.

11:45 **General discussion**

12:30 **Adjournment**

SOIL MECHANICS AND FOUNDATIONS DIVISION

Grand Ballroom

JOEL D. JUSTIN, *Chairman, Executive Committee, Soil Mechanics and Foundations Division, Presiding*

9:30 **Introductory remarks**

JOEL D. JUSTIN, *M. Am. Soc. C.E., Consulting Engineer*, Philadelphia, Pa.

9:40 **Accelerated Consolidation by Means of Vertical Sand Drains**

O. J. PORTER, *M. Am. Soc. C.E., Senior Physical Testing Engineer, Materials and Research Department, State Division of Highways*, Sacramento, Calif.

10:25 **Joint Discussion by**

KENNETH S. LANE, *Assoc. M. Am. Soc. C.E., Head, Soils Laboratory, U.S. Engineer Office*, Providence, R.I., and

REGINALD A. BARRON, *Jun. Am. Soc. C.E., Assistant Engineer, District Soil Laboratory, U.S. Engineer Department*, Providence, R.I.

(*Discussion to be presented by Kenneth S. Lane*)

10:35 **Discussion by**

THOMAS A. MIDDLEBROOKS, *Assoc. M. Am. Soc. C.E., Principal Engineer, Corps of Engineers, War Department, Office, Chief of Engineers*, Washington, D.C.

10:45 **Building Foundations on Compressible Soils**

RAYMOND E. MEANS, *M. Am. Soc. C.E., Associate Professor of Architecture, Oklahoma Agricultural and Mechanical College*, Stillwater, Okla.

11:30 **Discussion by**

ARTHUR CASAGRANDE, *M. Am. Soc. C.E., Associate Professor, Civil Engineering, Harvard University*, Cambridge, Mass.

11:40 **Discussion by**

RALPH E. FADUM, *Jun. Am. Soc. C.E., Assistant Professor, Soil Mechanics, Purdue University*, West Lafayette, Ind.

11:50 **General discussion**

12:30 **Adjournment**

STRUCTURAL DIVISION

West Ballroom

R. D. MINDLIN, *Chairman, Committee on Applied Mechanics, Presiding*

PROGRAM ARRANGED BY COMMITTEE ON APPLIED MECHANICS

9:30 **Introductory remarks**

R. D. MINDLIN, *Assoc. M. Am. Soc. C.E., Professor, Civil Engineering, Columbia University*, New York, N.Y.

9:35 **The Strength of Beams as Determined by Lateral Buckling**

KARL DE VRIES, *M. Am. Soc. C.E., Designer, Bethlehem Steel Company*, Bethlehem, Pa.

10:20 **Stability of Thin Shells in Torsion**

ROLLAND G. STURM, *Assoc. M. Am. Soc. C.E., Purdue University*, Lafayette, Ind.

11:05 **Buckling of Members Accompanied by Creep**

JOSEPH MARIN, *Assoc. M. Am. Soc. C.E., Professor, Engineering Mechanics, Pennsylvania State College*, State College, Pa.

11:50 **General discussion**

12:30 **Adjournment**

FRIDAY—January 19, 1945—Afternoon

CITY PLANNING DIVISION

JOINT SESSION WITH AMERICAN INSTITUTE OF PLANNERS

Rooms B and C

JOHN NOLEN, JR., *Chairman, Executive Committee, City Planning Division, Presiding*

2:30 **Introductory remarks**

JOHN NOLEN, JR., *Assoc. M. Am. Soc. C.E., Director of Planning, National Capital Park and Planning Commission*, Washington, D.C.

HAROLD M. LEWIS, *M. Am. Soc. C.E.; President, American Institute of Planners, Consulting Engineer*, New York, N.Y.

INFLUENCE OF INDUSTRIAL LOCATIONS ON THE POST-WAR DEVELOPMENT OF CITIES

2:40 **Economics as a Basis for Planning the Postwar Industries of the Metropolitan New York Region**

HOMER HOYT, *Director of Economic Studies, Regional Plan Association, Inc.*, New York, N.Y.

3:10 **Factors Controlling the Location of Various Types of Industry**

CHARLES P. WOOD, *Industrial Engineer, Lockwood Greene Engineers, Inc.*, New York, N.Y.

3:40 **Discussion by**

WALTER D. BINGER, *M. Am. Soc. C.E., Consulting Engineer, Binger-O'Connor-Orrok*, New York, N.Y.

5:00 **Adjournment**

SOIL MECHANICS AND FOUNDATIONS DIVISION

Grand Ballroom

JOEL D. JUSTIN, *Chairman, Executive Committee, Soil Mechanics and Foundations Division, Presiding*

2:00 Introductory remarks

JOEL D. JUSTIN, *M. Am. Soc. C.E., Consulting Engineer,* Philadelphia, Pa.

2:10 Field and Laboratory Testing for Soil Bearing Values (Engineering Foundation Project)

J. O. OSTERBERG, *Jun. Am. Soc. C.E., School of Civil Engineering, Technological Institute, Northwestern University,* Evanston, Ill.

2:55 Discussion by

GEORGE L. FREEMAN, *M. Am. Soc. C.E., Consulting Engineer, Moran, Proctor, Freeman and Mueser,* New York, N.Y.

3:05 Discussion by

PHILIP C. RUTLEDGE, *Assoc. M. Am. Soc. C.E., Professor, Civil Engineering, Technological Institute, Northwestern University,* Evanston, Ill.

3:15 Discussion by

WILLARD J. TURNBULL, *M. Am. Soc. C.E., Chief, Embankment, Foundation and Pavement Division, U.S. Waterways Experiment Station,* Vicksburg, Miss.

3:25 Stress-Strain Characteristics of Compacted Soil Systems

JOSEPH B. EUSTIS, *Jun. Am. Soc. C.E., Associate Engineer, U.S. Waterways Experiment Station,* Vicksburg, Miss., and

JOHN L. MCRAE, *Assistant Engineer, U.S. Waterways Experiment Station,* Vicksburg, Miss.

(Paper to be presented by Joseph B. Eustis)

4:10 Discussion by

DONALD W. TAYLOR, *Assoc. M. Am. Soc. C.E., Associate Professor, Soil Mechanics, Massachusetts Institute of Technology,* Cambridge, Mass.

4:20 Discussion by

REUBEN M. HAINES, *Assoc. M. Am. Soc. C.E., Engineer Corps of Engineers, U.S.A., Office, Chief of Engineers,* Washington, D.C.

4:30 General discussion

5:00 Adjournment

Meeting of the New York State Sewage Works Association

Salle Moderne—Hotel Pennsylvania—Seventh Avenue and 33rd Street

All Members of the Sanitary Engineering Division of the American Society of Civil Engineers Are Cordially Invited

FRIDAY—January 19, 1945—All Day

8:30 Registration

10:00 Annual Business Meeting

10:45 Practical Application of Principles of Modified Sewage Aeration

LLOYD R. SETTER, *Principal Sanitary Chemist, Department of Public Works,* New York, N.Y.

12:00 Luncheon

Presentation of Awards by

W. H. WISELY, *Executive Secretary-Editor, Federation of Sewage Works Associations' "Federation Activities"*

Guest Speaker: CHARLES A. EMERSON, *M. Am. Soc. C.E., Havens and Emerson, Consulting Engineers,* New York, N.Y. "Forty-five Years of Sewage Treatment"

2:15 Exploring the Effect of Heavy Doses of Chlorine on Sewage

A. E. GRIFFIN, *Assistant Director* and

N. S. CHAMBERLIN, *Sanitary Chemist, Technical Service Division, Wallace and Tiernan Company, Inc.*

3:00 Relation Between Loading and Supernatant Liquor in Digestion Tanks

WILLEM RUDOLFS, *M. Am. Soc. C.E., Chief, Department of Water and Sewage Research, New Jersey Agricultural Experiment Station,* New Brunswick, N.J., and LOUIS FONTENELLI, *Chief Operator, Rahway Valley Sewage Treatment Plant*

3:45 Coordinated Industrial Waste Research

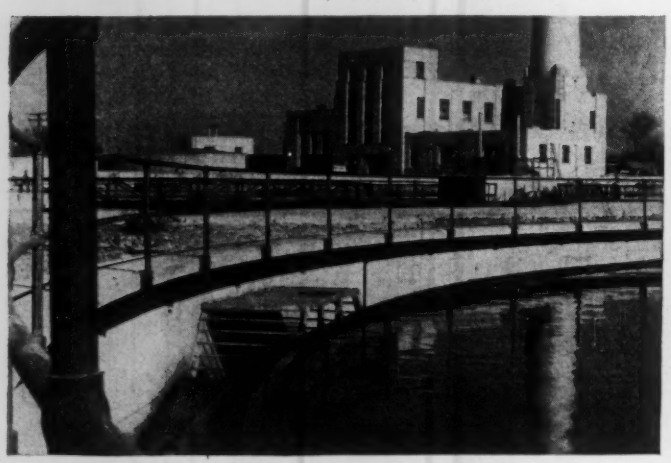
HARRY W. GEHM, *Technical Adviser, National Council for Stream Improvement, Pulp, Paper and Paperboard Industries, Inc.*

4:30 Plant Scale Tests on Thermophilic Digestion

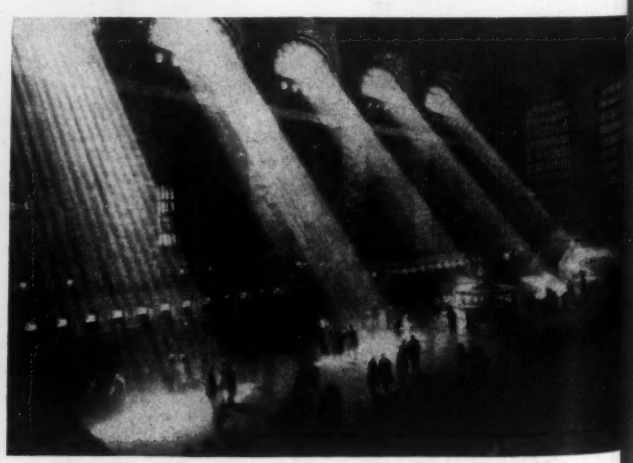
ANTHONY J. FISCHER, *Assoc. M. Am. Soc. C.E., Sanitary Development Engineer, The Dorr Company, Inc.,* New York, N.Y., and

R. A. GREENE, *Chemist, Sewage Treatment Plant,* Jackson, Mich.

5:15 Adjournment



SLUDGE DISPOSAL AND INCINERATION BUILDING, BUFFALO, N. Y.



SUNSHINE ILLUMINES GRAND CENTRAL STATION, NEW YORK

College Reunions Throughout the Week

TUESDAY—January 16, 1945

Columbia Engineers

The twenty-fourth annual informal dinner of the graduates of the Department of Civil Engineering of the School of Engineering of Columbia University will be held at the Faculty Club, Columbia University (117th St. and Morningside Drive), on Tuesday evening, January 16, 1945, at 6:30 p.m. The guest of honor will be Leo Wolman, Professor of Economics, who will discuss "The Labor Situation." Some modern materials testing devices will be demonstrated by Professor W. J. Krefeld.

The charge of $2.00 per cover will be collected at the dinner.

Supper Meeting of Cornell Society of Engineers

A supper meeting of the Cornell Society of Engineers will be held on Tuesday, January 16, 1945, at 6:30 p.m., at the Cornell Club, 107 East 48th Street, New York, N.Y.

Speakers will be D. H. Lauder, of the General Electric Company, who will tell of strange adventures of G.E. engineers in foreign service, and L. A. Swirbul, '20, Vice-President and Chief Engineer of the Grumman Aircraft, who will bring war stories and motion pictures of the famous Grumman Hellcats in action.

Buffet supper is $2.00. All Cornell engineers, whether members of the Society or not, are cordially invited. Reservations should be made as early as possible with Paul Reyneau, Secretary, Cornell Club (Plaza 5-7210).

THURSDAY—January 18, 1945

Luncheon of Chi Epsilon Honorary Civil Engineering Fraternity

For the eleventh consecutive year, members of Chi Epsilon, their families and friends, will meet for a very informal luncheon at the Midston House, 22 East 38th St., New York, N.Y., on Thursday at 12:45 p.m. The charge will be $1.50 per person. Make reservations through R. I. Land, % Abraham and Straus Co., 422 Fulton St., Brooklyn, N.Y. (Triangle 5-7200), or Room 1610, Engineering Societies Building.

University of Illinois Civil Engineering Alumni Dinner

The University of Illinois Civil Engineering Alumni and their friends will meet for the seventeenth annual informal dinner at 6:30 p.m., on Thursday at the Dinner-Smoker, Commodore Hotel. A private dining room has been reserved on the same floor as the Dinner-Smoker. Dinner-Smoker tickets are $2.50 for members and $3.50 for non-members of the Society. All tickets should be ordered from Society Headquarters, and if you wish to join the Illinois group, send your name to Harold T. Larsen (Pennsylvania 6-9220), Room 1610, Engineering Societies Building, New York, N.Y., or to M. N. Quade, Parsons, Brinkerhoff, Hogan and Macdonald, 142 Maiden Lane, New York, N.Y., phone Whitehall 3-0820.

Luncheon of M.I.T. Engineers

The annual M.I.T. Alumni Luncheon will be held at the Engineers' Club, 32 West 40th St., New York, N.Y., on Thursday, January 18, at 12:30 p.m. Please notify the Technology Club (Caledonia 5-7424) as to attendance.

Rutgers University Annual Dinner

Rutgers University Civil Engineering Alumni will meet for their annual dinner at 6:30 p.m., on Thursday at the Dinner-Smoker at the Commodore Hotel. A private dining room on the same floor as the Dinner-Smoker has been reserved for the reunion. Dinner-Smoker tickets are $2.50 for members and $3.50 for non-members of the Society. Members of the Society should order tickets direct from Society Headquarters, sending their names to C. H. Gronquist, Room 1104, 117 Liberty St., New York, N.Y., if they wish to sit with the Rutgers group. Non-members should order tickets from Mr. Gronquist.

FRIDAY—January 19, 1945

Brown Engineering Association

The Brown Engineering Association will hold its 31st annual dinner meeting at the Midston House, Madison Avenue and 38th Street, on Friday, January 19, 1945. Reception at 6:00 p.m., dinner at 6:30 p.m. Dr. Henry M. Wriston, President of the University, will be the principal speaker. All Brown alumni and friends are invited. The charge will be $2.00 per cover. Make reservations through Robert M. Bent, Griscom-Russell Co., 285 Madison Ave. (Lexington 2-3434).

Yale-Harvard-Princeton Engineering Association

The annual joint meeting of the Yale-Harvard-Princeton Engineering Association will be held at the Princeton Club, 39 East 39th St., New York, N.Y., on Friday, January 19 at 8:00 p.m. Preceding the joint meeting there will be a buffet dinner at the Princeton Club to which members of the three organizations and of the Am. Soc. C.E. are cordially invited. Dinner will begin promptly at 6:30 and the charge will be $2.00 each.

SATURDAY—January 20, 1945

Clarkson College Alumni Association

The annual meeting and dinner of the New York Section of the Clarkson College Alumni Association will be held at the Building Trades Employers Association Club, 26th Floor, 2 Park Ave., New York, N.Y., on Saturday, January 20, at 6:30 p.m. There also will be an informal luncheon and an afternoon meeting on the same day and in the same place.

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CROTON DAM, NEW YORK CITY WATER SUPPLY SYSTEM

Photo by Charles Phelps Cushing

LATE AFTERNOON SILHOUETTE OF LOWER MANHATTAN

Local Section Conference

TUESDAY—January 16, 1945—All Day

Room 1001, Engineering Societies Building

FRANCIS H. KINGSBURY, *Chairman, Society's Committee on Local Sections, Presiding*

Because of the cancellation of the Local Section Conference which was to have been held at the Cleveland Meeting last July, there will be a Local Section Conference during the Annual Meeting week in January. All Local Sections in the eastern area which were invited to send representatives to Cleveland have now been asked to participate in the Conference in New York.

The following Local Sections have been asked to send representatives:

Buffalo	Ithaca	Pittsburgh
Central Ohio	Lehigh Valley	Providence
Cincinnati	Maryland	Rochester
Cleveland	Metropolitan	South Carolina
Connecticut	Michigan	Syracuse
Dayton	Mohawk-Hudson	Toledo
District of Columbia	North Carolina	Virginia
Indiana	Northeastern	West Virginia
	Philadelphia	

Morning Session—9:30 a.m.–12:30 p.m.

9:30 Address of Welcome

WILLIAM MCK. GRIFFIN, *President, Metropolitan Section, Am. Soc. C.E.*, New York, N.Y.

9:40 Introduction of Local Section representatives

FRANCIS H. KINGSBURY, *Chairman, Committee on Local Sections*

10:00 The Engineer and Collective Bargaining

This subject will be introduced by a brief commentary by HOWARD F. PECKWORTH, *Assistant to the Secretary, Am. Soc. C.E.*, following which each Local Section representative will be called on to report on conditions within his own Section as related to the topic.

Following the report of each representative there will be general informal discussion.

12:30 Adjournment for luncheon

Afternoon Session—2:00 p.m.–5:30 p.m.

2:00 Address

MALCOLM PIRNIE, *President, American Society of Civil Engineers*

2:15 Planning for Postwar Construction

This subject will be introduced by brief addresses by G. DONALD KENNEDY, *Chairman of the Society's Committee on Postwar Construction*, and MARK B. OWEN, *Director of the Society's Committee on Postwar Construction*.

Following the introductory remarks by Messrs. Kennedy and Owen, opportunity will be provided for each Local Section representative to report on postwar construction planning as it is being handled in his area. Following the report of each representative there will be general informal discussion.

4:30 General Local Section Activities

The remaining time will be devoted to an informal discussion of any matters pertaining to Local Section activities, and opportunity will be provided for representatives to discuss and ask questions in connection with special problems or activities in their respective Sections.

5:30 Adjournment

General Announcements

Facilities of the Engineers' Club

Because of the general conditions prevailing in New York the Engineers' Club will be able to accommodate only a limited number of guests, for whom guest cards will be available at the Registration Desk. The price of rooms ranges from $3.00 upward and dining facilities will be available only to those staying at the Club. Requests for reservations should be made well in advance and addressed to Society Headquarters.

Your New York Address

At the Registration Desk a card file of those in attendance will be maintained, with information as to members' hotel addresses in New York. Members are requested to keep Society Headquarters informed as far as possible of their New York addresses so as to expedite the delivery of telegrams, telephone messages, and mail.

Regional Meeting Committee

This program has been prepared under the direction of the Committee on Regional Meetings, Richard E. Dougherty, Vice-President, Am. Soc. C.E., Chairman; and R. E. Bakenhus, V. T. Boughton, Charles B. Breed, George W. Burpee, Dean G. Edwards, and S. C. Hollister, Directors, Am. Soc. C.E.

Headquarters Hotel

The Commodore Hotel has been designated as Headquarters Hotel for the Annual Meeting. All functions, both technical and social, in connection with the 1945 Annual Meeting will be held at the Commodore, beginning Wednesday, January 17.

Columbia Broadcasting System, Broadcasts

Ladies from out of town may call at the Columbia Broadcasting System ticket office, 485 Madison Ave. between 51st and 52nd Sts., New York, between 9 a.m. and 5 p.m., and on presentation of proper credentials showing they are from out of town, will receive tickets for available broadcasts, limited to a maximum of 4 tickets a person.

Ladies' Committee

MRS. RALPH H. MANN, *Chairman*

MRS. R. E. BAKENHUS	MRS. R. E. DOUGHERTY
MRS. V. T. BOUGHTON	MRS. JOSEPH O. MAY
MRS. A. K. BURNHAM	MRS. M. N. QUADE
MRS. GEORGE W. BURPEE	MRS. GEORGE T. SEABURY
MRS. DEAN G. EDWARDS	MRS. HOMER R. SEELY
MRS. JAMES H. GRIFFIN	MRS. WILLIAM J. SHEA
MRS. WILLIAM MCK. GRIFFIN	MRS. CHARLES E. TROUT
MRS. CARL H. GRONQUIST	MRS. L. S. WATERBURY
MRS. ALFRED HEDEFINE	MRS. CHARLES W. WILLIAMS

MRS. CHILTON A. WRIGHT

Junior Members

EDGAR W. BISHOP	JAMES A. LINDSEY
ARCHIE N. CARTER	EDWARD E. LUSTBADER
EDWIN M. ERICKSON	JOSEPH MCCABE
JOSEPH M. KENNEDY	DON P. REYNOLDS
CHARLES A. KNAPP	CARL F. RUPP

Committee on Local Arrangements for the Annual Meeting

RALPH H. MANN, *Chairman*

A. K. BURNHAM	M. N. QUADE
JAMES H. GRIFFIN	HOMER R. SEELY
CARL H. GRONQUIST	L. S. WATERBURY
ALFRED HEDEFINE	CHARLES W. WILLIAMS
JOSEPH O. MAY	CHILTON A. WRIGHT

SOCIETY AFFAIRS

Official and Semi-Official

Society Prizes and Medals to Be Awarded

Members to Be Honored at the Annual Meeting for Outstanding Contributions to Society Publications

IN ACCORDANCE with its usual procedure, the Society will present prizes and medals at its Annual Meeting to be held in New York City, January 17–19, 1944. Oldest of these awards is the Norman Medal, which was established in 1872 by the late George H. Norman, M. Am. Soc. C.E., for an original paper that is considered an especially distinguished contribution to the profession. Next in point of importance is the J. James R. Croes Medal, established by the Society in 1912 and named in honor of the first President.

The late Thomas Fitch Rowland, Hon. M. Am. Soc. C.E., endowed the prize bearing his name in 1884. This award goes to a paper that best describes in detail some accomplished work of construction. For the paper considered second in merit to that awarded the Thomas Fitch Rowland Prize, the Society in 1912 established the James Laurie Prize, which was named in honor of the first President.

In 1894 the Collingwood Prize for Juniors was established by the late Francis Collingwood, M. Am. Soc. C.E., on his retirement as Secretary of the Society. To be eligible for this award papers must describe an engineering work or record an important investigation with which the author has been connected. Excellence of style is another governing factor in the selection of the paper receiving this prize.

This year the J. C. Stevens Award, which was established in 1943, is being presented for the first time. The award—to be given each year to the member of the Society submitting the best discussion of a paper in the field of hydraulics published in TRANSACTIONS—consists of books costing not more than $50, to be selected by each recipient.

Biographical sketches of the recipients of these prizes and medals follow.

RALPH B. PECK, Jun. Am. Soc. C.E., was born in Winnipeg, Canada, on June 23, 1912. He received his early education in Denver, Colo., and in 1934 graduated from Rensselaer Polytechnic Institute. He received the degree of C.E. and was awarded a fellowship to continue his studies leading to the degree of doctor of civil engineering in 1937. After eight months with the American Bridge Company, he attended the Graduate School of Engineering at Harvard University to study soil mechanics. From 1939 to 1942 he was employed as assistant subway engineer for the Department of Subways and Superhighways of the City of Chicago, being in direct charge of soil investigations and field measurements during construction of the initial system of Chicago subways. In 1942 he became chief engineer of testing for Holabird and Root, architect-engineers for the Scioto Ordnance Plant at Marion, Ohio. Beginning in 1941, he gave semi-monthly lectures on soil mechanics at the University of Illinois, and in December 1943 was appointed to his present position as research assistant professor of soil mechanics at that institution. He has served as consultant on foundation problems for several organizations, including James Stewart and Company; DeLeuw, Cather and Company; the Republic Steel Company; and the Sanitary District of Chicago.

NATHAN M. NEWMARK, Assoc. M. Am. Soc. C.E., was born in Plainfield, N.J., on September 22, 1910. After graduating from Rutgers University in 1930, he attended the University of Illinois as a graduate student and part-time assistant in civil engineering, receiving the degree of M.S. in 1932 and of Ph.D. in 1934. He then became a full-time member of the staff and was advanced to his present position of research professor of civil engineering in 1943. At the University of Illinois Professor Newmark has conducted and directed analytical and experimental research on such varied subjects as thin cylindrical metal shells, reinforced concrete arch bridges, monolithic concrete walls, reinforced concrete slabs, aircraft structures, and foundations. He has also served as consultant to the U.S. Navy Department, the U.S. Gypsum Company, and to McCloskey and Company, constructors of concrete ships for the U.S. Maritime Commission. At present he is on leave of absence from the University of Illinois in order to serve as technical observer and expert consultant for the Office of Field Service of the Office of Scientific Research and Development. He is serving on several committees of the Society, as well as committees of the American Concrete Institute and the Highway Research Board.

EUGENE L. GRANT, M. Am. Soc. C.E., was born in Chicago, Ill., on February 15, 1897. In 1917 he received the degree of B.S. in civil engineering, and in 1928 the degree of C.E., both from the University of Wisconsin. Following service in the U.S. Naval Reserve as seaman and ensign, he was assistant engineer for the Water Resources Branch of the U.S. Geological Survey. In 1920 he joined the faculty of Montana State College as instructor in civil engineering. Impressed by the fact that the question "will it pay?" had been given less attention than it deserved in the training of engineering students, he concentrated his major attention in the field of engineering economics. He spent the year 1923–1924 in various commercial departments of public utility companies in the Chicago area, and took graduate work in economics at the Universities of Washington and Wisconsin and Columbia University, receiving the degree of A.M. from the latter institution in 1928. He served, successively, as assistant professor and associate professor of civil engineering, and professor of industrial engineering at Montana State College until 1930, when he joined the faculty of Stanford University where he is now professor of economics of engineering. From 1931 to 1937 he was a member of the Board of Public Works of the city of Palo Alto. He is the author of *Principles of Engineering Economy* and of a number of professional papers on the economics of engineering.

GORDON R. WILLIAMS, Assoc. M. Am. Soc. C.E., was born in Newton, Mass., on March 26, 1906, and graduated from the Massachusetts Institute of Technology in 1929, with an S.B. degree in civil engineering. Following short periods with the U.S. Engineer Department and the Stone and Webster Engineering Corporation on plans for navigation and hydroelectric projects, he served eight years with the Water Resources Branch of the U. S. Geological Survey, where he was for three years on stream-flow investigations in New England, and for five years on special investigations in the Washington office. He is principal author of several papers on water supply. In 1939 he returned to the U.S. Engineer Department and for four years was engaged on flood protection projects in the Susquehanna River Basin in Pennsylvania—first in charge of hydraulic design in the Baltimore District, and later as area engineer under the Syracuse District in charge of design, construction, and operation. Since October 1943 he has been a senior hydraulic engineer in the Civil Works Division of the Office of the Chief of Engineers.

WALTER L. MOORE, Jun. Am. Soc. C.E., was born in Estrella, Calif., on March 12, 1916. He attended the California Institute of Technology, where he received his B.S. degree in 1937 and his M.S. degree in civil engineering in 1938. He was president of the Society's Student Chapter at the Institute during his senior year and a member of Tau Beta Pi. While doing graduate work he was a teaching assistant in the Testing Materials Laboratory. After completing his formal education he worked several months for the U.S. Engineer Office on the flood control project for the Los Angeles River. For about a year he was a junior engineer in the Soil Conservation Service Laboratory on the campus at the California Institute of Technology, where he did the research work reported in his paper, "Energy Loss at the Base of a Free Overfall." Since 1940 he has been in the structural research section of the Lockheed Aircraft Corporation at Burbank, Calif.

RALPH B. PECK

Norman Medal for Paper, "Earth-Pressure Measurements in Open Cuts, Chicago, Ill., Subway"

NATHAN M. NEWMARK

J. James R. Croes Medal for Paper, "Numerical Procedure for Computing Deflections, Moments, and Buckling Loads"

EUGENE L. GRANT

Thomas Fitch Rowland Prize for Paper, "Fundamental Aspects of the Depreciation Problem—Relationship to Competitive Industry"

BORIS A. BAKHMETEFF (Left)

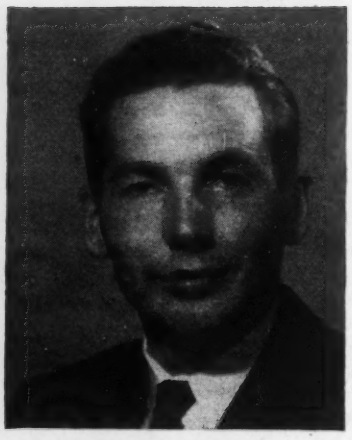
and

NICHOLAS V. FEODOROFF (Right)

J. C. Stevens Prize for Discussion of Paper, "Profile Curves for Open-Channel Flow"

GORDON R. WILLIAMS

James Laurie Prize for Paper, "Drainage of Leveed Areas in Mountainous Valleys"



WALTER L. MOORE

Collingwood Prize for Junior for Paper, "Energy Loss at the Base of a Free Overfall"

BORIS A. BAKHMETEFF, M. Am. Soc. C.E., was born in Tiflis Russia, in 1880, receiving his early education at the Tiflis Classical Gymnasium. He received the C.E. degree from the Institute of Engineers of Ways of Communications in St. Petersburg in 1903, and spent the following year at the Zurich Polytechnic Institute. In 1911 he received the doctor of engineering degree from the St. Petersburg Polytechnic Institute, where he served as professor of general and advanced hydraulics and water power engineering from 1905 to 1917. Coincidentally for part of this period (1907 to 1915) he maintained a consulting practice in St. Petersburg. At the beginning of the first World War he enlisted with the Red Cross. In 1915 and 1916 he was chief plenipotentiary of the Central War Industrial Commission to the United States and a member of the Anglo-Russian Purchasing Commission. Representing the Provisional (Kerensky) Government in the United States in 1917, Professor Bakhmeteff continued as ambassador of the State of Russia until 1922. Since 1923 he has maintained a consulting practice in New York City, and since 1931 he has also been professor of civil engineering at Columbia University. He became a citizen in 1935. He is the author of *Varied Flow of Liquids* (1914), *Hydraulics of Open Channels* (1932), and *Mechanics of Turbulence* (1936), and at present is chairman of the Society's Hydraulics Division. In 1937 Professor Bakhmeteff was the recipient of the James Laurie Prize.

NICHOLAS V. FEODOROFF, Assoc. M. Am. Soc. C.E., was born in Russia on November 30, 1901. In 1919 he graduated from the Classical Gymnasium in Russia, but his normal studies were interrupted by the disturbed conditions. From 1922 to 1927 he was employed on the construction of highways and railroads in Bulgaria, and from 1927 to 1929 he attended Svobodnya University, receiving a certificate from the Department of Finance and Administration. He received the B.S. degree from the Columbia University School of Engineering in 1935, and the C.E. degree in 1936. From the latter year to 1938 Mr. Feodoroff was research assistant in the civil engineering department at Columbia University, making special studies of the phenomena of "Flow Through Granular Media." From 1938 to 1939 he was research engineer for the Honolulu (Hawaii) Board of Water Supply and from 1942 to 1944 visiting associate professor in the Manhattan College School of Engineering. Since 1939 he has also been research associate in civil engineering at Columbia University. He is co-author of a number of articles, on "Flow Through Granular Media," as well as a series of discussions on hydraulics which have been published in the PROCEEDINGS of the Society.

Five New Honorary Members of the Society

ARTHUR JAMES DYER

THROUGHOUT his career, Arthur James Dyer has taken such an intense interest in structures that it is small wonder his pride in his farm outside Nashville, Tenn., is not so much in the crops, the animals, or the equipment, as in the continuous, rigid-frame trusses that carry the roof of the barn. This interest has grown rather than diminished since his first work on structures with the Phoenix Bridge Company in 1891, following graduation from Vanderbilt University.

ARTHUR JAMES DYER

After connections with several bridge companies in various capacities, Mr. Dyer organized the Nashville Bridge Company and in 1902 became its president and chief engineer. This position he held until 1940, when he became chairman of the board of the company and Harry B. Dyer, his oldest son, assumed the presidency.

Although he was born in Massachusetts (Medford, in 1868), Arthur Dyer's family moved to Chattanooga, Tenn., when he was a youngster and during long years in the area he has acquired the warm sociability and gracious manner so often associated with the South. His interest in "folks" is evidenced by the long list of community betterment organizations with which he is affiliated. His enthusiasm has resulted in frequent election to positions of responsibility in these organizations. Such groups include the Board of Transportation Trustees of the City of Nashville, the Nashville Rotary Club, the Chamber of Commerce, the Planning and Zoning Commission, and the county Zoning Board. He is a director of the American National Bank of Nashville. His memberships include several social clubs and he is a thirty-second degree Mason.

Whenever time has permitted, Art Dyer has gone off on a big game hunting expedition with some of his friends. These trips have taken him to Alaska and British Columbia after caribou, moose and mountain sheep. In Arizona and Mexico he has bagged mountain lions and antelope. His continued good health he owes, among other things, to his accuracy with a high-powered rifle. On a trip in Alaska an unexpected turn of events brought him face to face with an enraged grizzly bear. Fortunately his unerring aim bagged the bear a split second before the bear could bag him.

In his profession, Mr. Dyer has many accomplishments to take pleasure in. During the First World War he designed 2,500-ton oil tankers for the Emergency Fleet Corporation along with the yard in which to construct them. Design of the facilities was complicated by a fluctuation in river level amounting to about 45 ft. Since that time he has designed, and his company has built, more than 700 items of river equipment including dredges, tugboats, barges and, most recently, PC boats and APL personnel boats for the Navy.

The Nashville Bridge Company, under Mr. Dyer's direction, has built many prominent bridges throughout the South and in Mexico. In addition to boats and bridges, a wide variety of structures have been designed, fabricated, and erected, including commercial and monumental buildings, transmission towers, aircraft hangars, observation towers, and unusual recreational devices.

Not limiting his endeavors to structures, he has pioneered in the organization of power developments in the Tennessee Valley. As a farmer he has recently produced some of the finest alfalfa raised in Davidson County.

Mr. Dyer was one of the early leaders in the American Institute of Steel Construction, having helped to organize it in 1921. He has always taken an active part in the administration of the Institute and has served on its Board of Directors for more than 18 years. He also has been chairman of, and served on, various committees of the Institute. Fellow members consider him one of the most active men in the organization as well as in the structural steel industry.

For a still longer period he has been associated with the American Society of Civil Engineers (since 1901), and here too his energy has been capitalized. He served as Director from 1922 to 1924, and as Vice-President from 1929 to 1930. Long-sustained influence in his profession has resulted in the award of Honorary Membership in the Society to Mr. Dyer.

CHARLES PHILIP GROSS

A MATTER of utmost concern to all Americans and their allies, the threatened railroad strike in December 1943 was a very personal problem for Charles Philip Gross, Major General, U.S. Army. He was directed to prepare plans to take over operation of the nation's railroads with all speed—on the eve of the wedding of his daughter Nancy. Duty bound, he stuck to his job until plans were roughed out and only at the last minute arrived to give the bride away. Needless to say such devotion to duty has marked the career of General Gross in the Army ever since his graduation from West Point in 1914.

CHARLES PHILIP GROSS

It was as a youth in Brooklyn, N.Y., that he gained the superb self-control that is so much a part of his character. At the age of eight he possessed a violin and a fiery determination not to play it. He would have thrown the instrument, case and all, into the river had it not been for his desire to please his mother. So he practiced dutifully and diligently, until he became quite proficient. Today he is grateful for that effort, for in his rare moments of relaxation that same violin affords him much pleasure.

General Gross now heads the youngest—and one of the largest—branches of the Army Service Forces, the Transportation Corps. This organization of experts in water, rail, and highway transport is directing the greatest traffic management job in history. Movement of troops and supplies across the seas and to and from battlefields is their job. Officially the General is Chief of Transportation. Unofficially he is often called the "Traffic Manager" of the War Department and as such has earned the respect and praise of all transportation men who have had contact with his organization.

Shortly before graduation from Cornell in 1910, Charles Gross was given the opportunity to accept an appointment to the U.S.

Military Academy and he made the decision without hesitation. Always keen on the life at West Point, he graduated third in his class in 1914. Later Cornell awarded him his degree in mechanical engineering.

After several years of active Army duty he was assigned to the 318th Engineers and with them participated in the occupation of the Gerardmer Sector and in the Meuse-Argonne offensive in 1918. For those services, he was awarded the Meritorious Services Citation by General Pershing and the Order of the Purple Heart.

Between assignments of duty, General Gross studied at the Command and General Staff School at Fort Leavenworth, Kans., and at the Army War College in Washington, D.C. From both he was graduated with superior rating. His duties have carried him to many parts of the nation as well as to Nicaragua and to Russia.

General Gross became the Army's first Chief of Transportation with the organization of the Transportation Service, Services of Supply, in March 1942. When the Transportation Service was established as a separate corps in July of that same year, he was promoted to Major General. His responsibilities have made it necessary for him to visit all the theaters of war, some of them on several occasions.

The war has left General Gross little opportunity to enjoy his favorite recreations—golf, bridge, and tennis. Both he and Mrs. Gross are expert bridge and tennis players and in days when he could spend a little more time at his Ft. Myer, Va., home, they were often seen playing together. Although he admits that he holds a margin for the first couple of games, he quickly adds, "But if we played two sets, she would surely beat me!"

A devoted father and husband, he has keyed his whole economy to providing for his five children the best of care and education. His three daughters have followed the Army tradition and married officers—all of whom are serving overseas. The older son, John, is a Navy lieutenant, while Sheldon is finishing his work at Haverford College.

General Gross's magnetic personality and marked social graces are impressive, and in interviews he exhibits a sparkling clarity of thinking and direct approach. He is quick to make decisions and firm in standing by them. Subordinates are required to be absolutely forthright and he backs them to the limit. The letters that reach him from men at all points of the compass who have once been his associates demonstrate his ability to make friends with those he deals with.

The gratitude he holds for those who took part in formulating and developing his character and in guiding his education is proved by the cordial contacts he maintains with his teachers of early school days. Many times the General and Mrs. Gross have been counted among those present at the alumni dinners of old Public School No. 85—the school they both attended in Brooklyn.

He has always looked upon his work as a challenge to be accepted and met. That this has brought him singular success is evidenced by the award of Honorary Membership in the Society.

HORACE WILLIAMS KING

TO HUNDREDS of engineers throughout the world, Horace Williams King typifies the patient, painstaking professor, sharing a limitless fund of knowledge with an oncoming generation. It is probably his consideration for the needs and aspirations of others that has firmly implanted this picture in so many minds. But in addition to his influence as a teacher, Professor King has also been a pioneer in the development of hydraulic equipment and in the preparation of handbooks and tables.

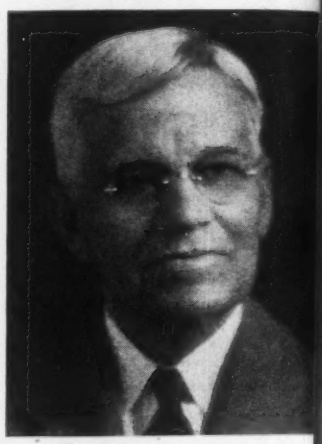
When Horace King was born in Big Rapids, Mich., on February 10, 1874, the science of hydraulics was largely confined to academic studies. Few applications had been made to the design and construction of engineering structures. In his earliest jobs, Professor King found that much research would be needed if tables and formulas and tools were to make design more practical and more trustworthy. His accomplishments in filling this need speak well for his perservering efforts.

Practice of his profession carried Professor King around the world, with assignments in Nicaragua, the Philippine Islands, and China. In the course of his work and in later travels he came to know, respect, and understand the people of other lands. And so, when he joined the staff at the University of Michigan, his Ann Arbor home became a haven for the foreign students in his classes and their friends. As a result of friendships thus formed, coupled with his reputation, many foreign students have since been attracted to the "U. of M."

During his continuous service at Michigan, Professor King has been called upon time and time again for his wise counsel on matters dealing with flood prevention, irrigation, and hydroelectric developments throughout the United States. He was one of the principal witnesses in the famous Chicago Sanitary District diversion case that was tried before the Hon. Charles Evans Hughes. Later he was asked to serve on the National Water Power Policies Committee of the U.S. Chamber of Commerce. This committee has formulated policy in relation to national aspects of water power development which will serve as a guide in the enactment of future legislation.

Administrative work as a faculty member of the College of Engineering brought Professor King into close contact with the personal problems of many students. Those in need of help have found that he gives of his time and friendship as well as of his money. Those who were in trouble due to infraction of the rules have found that despite the severe penalties he has sometimes been forced to mete out, they have not ceased to respect and honor him, because of his fairness and good judgment.

This sense of fairness and his utter contempt for sham and pretense have enabled him in his scholarly work to cut through to fundamentals, and some outstanding texts and handbooks have resulted. Among these are the *Handbook of Hydraulics*, *Hydraulics* (which has been published in several languages), and his work on the Manning tables and on irrigation and drainage. Through the medium of his writings, Professor King strongly advocated the use of the Manning formula as a substitute for the old and previously almost universally used Kutter formula for flow in pipes and open channels. Professor King was the first American engineer to advocate this change. At the time of his first publication on this subject, the Manning formula was practically unknown in this country. As a result of his efforts, alone and unaided, it has been almost universally adopted throughout the United States.



HORACE WILLIAMS KING

The Professor has always loved a joke even though it were on himself. As one instance, he tells how, on a trip to Saginaw, he found the city packed with convention goers, and considered himself fortunate to have a room at one of the best hotels. When planning his departure, he deliberately chose a train that left at 12:01 so that he could leave his room before the close of one business day, finish his business, and catch a train after a leisurely evening. In the rush of checking out of the hotel he had failed to read on the time table the small type "p.m." His pride kept him from going back to the hotel, so he spent an uncomfortable night on a hallway cot waiting for the 12:01 p.m. train—the next noon.

The King-Seeley Corporation, manufacturer of gages used in many fields, was organized by Professor King to make a new type of gage developed in his research studies. The growth of this concern evidences the soundness of the device.

Unfortunately, in all his endeavors he has not been so successful if playing bridge can be considered an endeavor. Though it is one of his principal recreations he has found that no formulas or curves or tables will in the least affect the uniformly bad hands he holds. Also a diligent reader of current writings, the professor is extremely keen on current events throughout the world—particularly those affecting human relations.

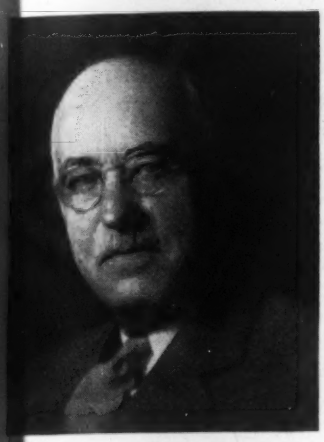
Active with the American Society of Civil Engineers since 1910, Horace King is also a member of the Society for the Promotion of Engineering Education, the American Meterological Society, and is an Honorary Member of the Michigan Engineering Society. Now those who have known him and his work best have recognized his eminence in his chosen field by awarding him Honorary Membership in the Society.

LOUIS CARLTON SABIN

A CONSTANT reminder of the work of Louis Carlton Sabin is presented to travelers on the Great Lakes as they pass through the locks at the Sault Ste. Marie. Here one of the longest locks in the world is named the Sabin Lock in recognition of his long association with, and responsibility for, construction operations at the "Soo." Most of his career Louis Sabin has spent in the U.S. Government service. It was only after many years of service that he left his position as Superintendent of the St. Mary's Falls Canal to become vice-president of the Lake Carriers' Association in Cleveland.

Soon after his graduation from the University of Michigan, Mr. Sabin established a reputation by publication of a technical work called *Cement and Concrete*. This has been circulated widely and used as a college textbook. It was prepared following extensive investigations in connection with construction of the Poe Lock at Sault Ste. Marie just before the turn of the century.

From one position to another he was advanced until he became Superintendent of the Canal in 1905. This position of responsibility he held for 20 years. Always interested in the appearance of improvements to the Canal as well as in their technical details, he was responsible for having the canal grounds beautified by well-planned landscaping. This interest in horticulture carried over to a very attractive arrangement of the planting of the grounds which surrounded the Sabin home.



LOUIS CARLTON SABIN

The Sabin home, as well as the cottage on the St. Mary's River, was at all times a focal point of social interest for many friends, including Gen. E. M. Markham, M. Am. Soc. C.E., George H. Fenkell, Hon. M. Am. Soc. C.E., ex-governor of Michigan, Chase Osborn, and others. In this company was always an atmosphere of informal companionship with good humor.

During his residence at the "Soo," Mr. Sabin was one of the leaders in community activities. He was founder and at one time president of the Soo Rotary Club. He was also a member of the library board, the hospital board, and he participated in the organization of the Y.M.C.A. When he moved to Cleveland this concern for community functions manifested itself immediately and he became active in the Cleveland Rotary and the Cleveland Chamber of Commerce besides becoming a board member of the Ohio State Chamber of Commerce.

The move to Cleveland was made in 1925 when, because of his intimate knowledge of navigation, gained during long years of experience with river and harbor improvements, he was asked to assume a position with the Lake Carriers' Association. Here his characteristic thoroughness and fine administrative shrewdness have made him invaluable. His thoughts and planning are forward looking, more likely to be based on the needs of the future than solely on immediate considerations. In his business contacts his direct and fearless manner avoids all misunderstandings. His reports are clear and concise, indicating that he has the gift of expressing himself clearly. On several occasions he has contributed to Society publications.

He makes no claim to athletic prowess although until recently he offered real competition on the handball court and at an occasional round of golf. His gardens have been his pride, and indeed he has been a prize winner in vegetable and flower exhibits at local county fairs. As an example, he was one of the first to raise sweet peas successfully in the severe climate of northern Michigan.

Mr. Sabin has exhibited the true lake traveler's distrust of land transportation facilities. He has never shown any enthusiasm for riding in automobiles and has never driven one. In fact, some concern has been expressed as to whether he will be willing to trust New York City taxis when he attends the January meeting.

Perhaps the most important single project under Mr. Sabin's direction while he was at the Sault Ste. Marie was the design and construction of the navigation locks, which were completed in 1919. These locks, the longest in existence, have since passed nearly 2 billion tons of freight. The lock completed in 1914 was called the "Davis Lock" at the suggestion of Mr. Sabin and the lock finished five years later, the "Sabin Lock" by action of Congress. The Secretary of War in an approving address named the lock in honor of "Mr. Louis C. Sabin...whose long period of service in the Engineering Department was exceptionally able and meritorious."

Since his first association with the American Society of Civil Engineers in 1893, his interest in the Society has continued unabated. For this reason it is fitting that the Society should acknowledge his outstanding engineering achievements by making him an Honorary Member. Mr. Sabin is also an Honorary Member of the Cleveland Engineering Society and of Tau Beta Pi, and is enrolled in the Propeller Club of Cleveland.

ARTHUR SURVEYER

STUDIES at universities on two continents prepared Arthur Surveyer for a distinguished career in civil engineering. Two of his academic degrees were earned in Montreal, Quebec—Bachelor of Arts from Laval University in 1898 and Civil Engineer and Bachelor of Applied Sciences from the Ecole Polytechnique in 1902. During the next two years he took postgraduate work at the Ecole Special d'Industrie et des Mines du Hainaut in Mons, Belgium. In recent years, Dr. Surveyer has received honorary degrees from Rensselaer Polytechnic Institute and from the University of Montreal.

Upon completion of his studies in Belgium, Surveyor returned home for a position with the Department of Public Works of Canada. (Montreal was and is home to Arthur Surveyer, for he was born there in 1878 and has maintained an office there for many years.) After several years of experience on design and construction, he established the firm of Arthur Surveyer and Company. For 33 years this firm has designed and supervised many important engineering works and has specialized in investigations for banking firms, public utilities, and industrial corporations.

Among these assignments were the preliminary design and estimate for a 240,000-hp development on the Ottawa River at Caribou; preliminary design and estimate for a 70-ton Kraft paper mill; plans for a 1,500,000-gal reservoir of reinforced concrete for the Canadian Pacific Railway; design and supervision of the construction of a six-story department store in Montreal for Dupuis Frères.

Dr. Surveyer's ability as an impressive, serious, and mildly witty after-dinner speaker is well known. It was demonstrated at the Special Meeting of the Society held in Buffalo a number of years ago, when he responded for Canada to a toast to the engineering profession. When he finished, the whole company stood up and gave him a hearty reception.

ARTHUR SURVEYER

On a famous occasion in Toronto when engineers from all over the Dominion were gathered for what was termed a "tribal shout" to celebrate the selection of an engineer as Chairman of the Ontario Hydroelectric Power Commission, Dr. Surveyer stole the show, notwithstanding the fact that well-known speakers from other professions were present. Like all good speakers, he thinks his own efforts are terrible and he does his best to avoid special assignments, but once he takes one on he can be depended upon for an original, apt, timely, and appealing speech.

One of Dr. Surveyer's principal interests in recent years has been the Canadian Institute of International Affairs, of which he was one of the founders and is today one of the directors. Perhaps there are few Canadians, outside of those who are giving full time in the diplomatic service and other fields of international affairs, who are better posted on international questions than he. At nearly every round-table discussion on these matters on either side of the boundary among semi-official and unofficial groups during the last ten years he has been one of the principal speakers.

Dr. Surveyer has taken a very deep and continuous interest in the Ecole Polytechnique, the French-Canadian Engineering Faculty connected with Montreal University. The fact that graduates from this faculty are sought after, and are today occupying important positions, throughout industrial Quebec is due to a large extent to his leadership. In the Great War, Dr. Surveyer was asked by the Government of Canada to help organize the National Research Council—a body of leading Canadian scientists from the principal universities, with two consulting engineers, one the late Dr. R. A. Ross, Past-President of the Engineering Institute of Canada, and the other Dr. Surveyer, also a Past-President of the Institute. Dr. Surveyer is still a member of the Research Council, which has been responsible for inspiring the solution to technical problems of tremendous import to Canada's war effort.

Perhaps the best example of the difficulty of applying theory to practice is that to be found in Dr. Surveyer's outstanding ability to explain the theory of hooks and slices in golf, accompanied by his great difficulty in keeping his score below 100. Dr. Surveyer can expound learnedly upon the reasons for each of the six different kinds of slices, but he cannot explain why on the fairway in the course of a game he cannot keep from demonstrating each of these different kinds at least once. Notwithstanding his learned expertness on the theory of golf and his ability to expound his theory, he is a popular member of the Royal Montreal Golf Club, the oldest and the original golf organization on this continent, founded in 1872. All his English friends envy him his outstanding ability to use the King's English, both in speech and in writing, although at all times he is most retiring and unassertive.

In addition to his engineering practice, Dr. Surveyer has served as director of the Shawinigan Water and Power Company, the Chromium Mining and Smelting Corporation Ltd., and the Holland-Canada Mortgage Bank. He also has been Commissioner-Censor of Credit Foncier Franco-Canadien. He was a member of the Canadian Council for Industrial and Scientific Research from 1917 to 1924, of the Canadian National Research Council from 1942 to date, and of the Canadian Advisory Committee on Reconstruction in 1943.

Dr. Surveyer became a Member of the Society in 1924. He is also a member of the Engineering Institute of Canada, of which he was president in 1924 and 1925, being one of four men to hold this position for more than one year since the founding of the Institute in 1880. He is also a member of the Corporation of the Ecole Polytechnique de Montreal, the Corporation of Professional Engineers of Quebec, the American Economic Association, and the American Management Association. He is the representative of the Engineering Institute of Canada on the Council of the Engineering Council for Professional Development, and is chairman of the Committee on Postwar Policies of the Canadian Chamber of Commerce.

Thus it is an outstanding French-Canadian member of the profession who becomes an Honorary Member of the Society in the person of Dr. Surveyer.

Send in Your New Address

BECAUSE of the paper shortage, which is still acute, Yearbook cards, for the purpose of obtaining changes in members' addresses, will not be sent out this year.

Since the war, there has been an enormous number of changes throughout each year, and the staff has worked hard to keep these changes up to date on Society records. Furthermore, each time a postoffice notice is received, to the effect that an address is no longer correct, a letter is written to the member at the new address for further information. It is felt, therefore, that in most cases the addresses as they appear in our master file are substantially correct.

If there are any members who have not informed Headquarters recently of a new address or change in title or position, they are requested to do so immediately. The deadline for changes for the 1945 Yearbook is February 1.

Link of Society's Committee on Postwar Construction with C.E.D.

TO COOPERATE more fully in the stimulation of postwar planning by private concerns, the Society's Committee on Postwar Construction has entered into an agreement to serve as an Action and Advisory Committee of the Committee for Economic Development (C.E.D.). President Pirnie will serve as chairman of the committee. The advantages of this move will be manifest on a community level, where the advice and assistance of members of the Society's Local Section committees will be extended to local C.E.D. groups urging the preparation of definite plans for postwar construction.

This nationwide effort will bring about a closer collaboration of engineers with business and industrial leaders. The C.E.D. is a private, non-profit organization which, while completely independent of any government or private agency, is enlisting the aid of both individuals and organizations in a drive to provide for new high levels of productive employment after the war has been won. The work is financed entirely by contributions from private business.

While the campaign of the C.E.D. has been conducted on a nationwide basis, with a national chairman and board of directors, the bulk of the promotional work has been carried on by over 2,000 local committees—each one dealing with the problems of its own community. Thus, while the Society's Committee on Postwar Construction will become a part of the C.E.D. Action and Advisory Committee, it will with the community organizations that the Society's Local Section committees will confer.

In offering this assistance to the C.E.D., the Committee on Postwar Construction will not relax its efforts as a separate organization to guide both private and public construction agencies in getting their plans ready. The committee, under the direction of G. Donald Kennedy, chairman, has been conducting tests for several months to ascertain the effectiveness of such cooperation with C.E.D. and has found results most encouraging.

One of the first actions taken by the Committee on Postwar Construction was to furnish each of the C.E.D. community organizations with a copy of the bulletin "Postwar Construction." The program proposed by the Board of Direction of the Society on July 29, 1943 (see CIVIL ENGINEERING for September 1943, p. 439), will thus be placed before business men and industrialists throughout the country.

Construction Engineering Prize Goes to Fred W. Stiefel

ANNOUNCEMENT has already been made of the award of the Construction Engineering Prize to Fred W. Stiefel, Assoc. M. Am. Soc. C.E., for his article, "Inclined Mine Shaft Sunk in the Adirondacks," which was published in the April 1944 number of CIVIL ENGINEERING. The Construction Engineering Prize, which was established in 1939 through the generosity of A. P. Greensfelder, M. Am. Soc. C.E., is the only award specifically limited to material appearing in CIVIL ENGINEERING. Presentation will take place at the time of the Annual Meeting in January.

FRED W. STIEFEL

For the past twenty years Mr. Stiefel has been actively engaged in bidding and consummating contracts and in managing large heavy-construction projects. The work on which he has been engaged includes nine subway contracts totaling $55,000,000, the Manhattan Intercepting Sewers, fifteen miles of the New York City Delaware Aqueduct, the Manhattan Pla

of the Midtown Tunnel, the Third Gatun Locks of the Panama Canal, and El Mirador Tunnel for the Government of Mexico, near Puebla, Mexico.

Having completed the 2,000-ft shaft, described in Mr. Steifel's paper, his company is engaged in developing six levels leading from this shaft and the actual mining of the iron ore.

Strike Delays December "Proceedings"

OVER an unusually long period of years (approximately eight), the Society has faced the need of apologizing for the late mailing of PROCEEDINGS only a very few times. On these rare occasions the reasons have been several, but never before has it been necessary to plead that copies were delayed because there was nothing to mail them in.

The envelopes for the December number were shipped to the printer in Lancaster, Pa., on December 12, all properly addressed and ready for the insertion of PROCEEDINGS. The Motor Express Company presumably delivered the consignment, as required, to the local express company. The latter, under the duress of local union demand, prevented the through-freight company from making a direct delivery to the printer's plant.

With the envelopes properly in line for the last stage of their journey—namely, the short distance by local express in Lancaster, Pa., to our printer in that city—the delay occurred. The envelopes have been, as it were, impounded as a result of the local strike, over the results of which the Society has no concern or interest But this local disturbance between employer and employee is being felt throughout the entire Society membership.

As to when the December PROCEEDINGS will reach you under the circumstances, your guess is as good as ours.

Supplement to Mexican Water Treaty

A PROTOCOL, clarifying the treaty with Mexico for utilization of the waters of the Colorado, Rio Grande, and Tijuana rivers, was signed in Washington on November 14, 1944, by Secretary of State Stettinius and Ambassador Nájera of Mexico. This supplemental agreement was made public on November 24 and read into the Congressional Record, in accord with Mr. Stettinius's announced policy of making treaties public information. For an appraisal of the treaty, which was signed February 3, 1944, but not yet ratified as this issue goes to press, see CIVIL ENGINEERING for December 1944, page 531. The protocol as printed in the Congressional Record is reproduced here:

"The Government of the United States of America and the Government of the United Mexican States agree and understand that:

"Wherever, by virtue of the provisions of the Treaty between the United States of America and the United Mexican States, signed in Washington on February 3, 1944, relating to the utilization of the waters of the Colorado and Tijuana Rivers and of the Rio Grande from Fort Quitman, Texas, to the Gulf of Mexico, specific functions are imposed on, or exclusive jurisdiction is vested in, either of the Sections of the International Boundary and Water Commission, which involve the construction or use of works for storage or conveyance of water, flood control, stream gaging, or for any other purpose, which are situated wholly within the territory of the country of that Section, and which are to be used only partly for the performance of treaty provisions, such jurisdiction shall be exercised, and such functions, including the construction, operation, and maintenance of the said works, shall be performed and carried out by the Federal agencies of that country which now or hereafter may be authorized by domestic law to construct, or to operate and maintain such works. Such functions or jurisdictions shall be exercised in conformity with the provisions of the Treaty and in cooperation with the respective Section of the Commission, to the end that all international obligations and functions may be coordinated and fulfilled.

"The works to be constructed or used on or along the boundary, and those to be constructed or used exclusively for the discharge of treaty stipulations, shall be under the jurisdiction of the Commission or of the respective Section, in accordance with the provisions of the Treaty. In carrying out the construction of such works the Sections of the Commission may utilize the services of public or private organizations in accordance with the laws of their respective countries.

"This Protocol, which shall be regarded as an integral part of the aforementioned Treaty signed in Washington on February 3, 1944, shall be ratified and the ratifications thereof shall be exchanged in Washington. This Protocol shall be effective beginning with the day of the entry into force of the Treaty and shall continue effective so long as the Treaty remains in force.

"In witness whereof the respective Plenipotentiaries have signed this Protocol and have hereunto affixed their seals.

"Done in duplicate, in the English and Spanish languages, in Washington, this fourteenth day of November, 1944.

"For the Government of the United States of America:

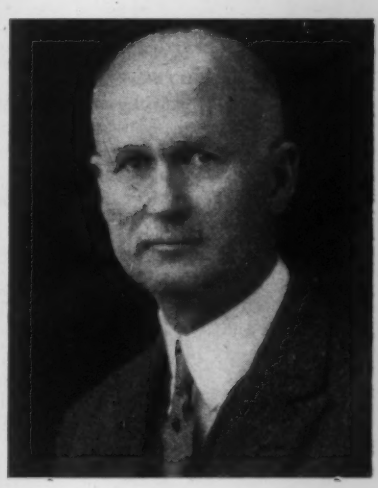
[SEAL] E. R. STETTINIUS, JR.,
Acting Secretary of State of the United States of America.

"For the Government of the United Mexican States:

[SEAL] F. CASTILLO NÁJERA,
Ambassador Extraordinary and Plenipotentiary of the United Mexican States in Washington."

A. J. Hammond, Past-President and Honorary Member, Dies

MEMBERS of the Society will be grieved to hear of the sudden death of Alonzo J. Hammond, Past-President and Honorary Member of the Society, which took place in Washington, D.C., on December 1, 1944. Mr. Hammond, who for the past four years had been assistant chief of the price adjustment section of the War Department, was fatally stricken as he prepared to leave his hotel apartment for his office. His age was 75.



ALONZO J. HAMMOND

Mr. Hammond was born in Thorntown, Ind., on April 23, 1869, and graduated from Rose Polytechnic Institute in 1889, receiving the degree of M.S. in 1894 and that of C.E. in 1898. He also took a postgraduate course at the Massachusetts Institute of Technology in 1890 and 1891. From 1893 to 1901 he was assistant engineer on the Terre Haute and Indianapolis Railway, and from 1901 to 1909 city engineer of South Bend, Ind.

In 1910 he went to Chicago as consulting engineer for the Commission on City Expenditures and in 1911 was chief engineer of the Bureau of Public Efficiency. During the next two years he was engineer of bridges and harbors in the Chicago Department of Public Works. In 1914 he was engaged as consulting engineer for the Chicago Union Station, and later became assistant chief engineer in charge of the engineering design and construction of that $75,000,000 passenger terminal. Resigning this connection in 1922, he joined James O. Heyworth, Inc., as chief engineer, and for the next three years was active in the design and construction of hydroelectric plants.

In 1927, following two years as chief engineer of the Mellon-Stuart Company, Mr. Hammond established a private consulting practice in Chicago, which he maintained until his death. During his years as consultant he was often retained by the City of Chicago and other municipalities on various projects, such as river straightening, dock walls, bridges, and viaducts. Early in 1941 he was invited to Washington to accept a post in the War Department.

Long active in the Society, Mr. Hammond served as Director from 1926 to 1928, as Vice-President in 1929 and 1930, and as President in 1933. He was elected Honorary Member in 1942. He had also been prominent in the Illinois Section, of which he was a former president.

The Significance of the Labor Relations of Engineers with Their Fellow Employees

This address by William H. Davis, Chairman of the National War Labor Board, was delivered before the Metropolitan Section in New York, N.Y., on November 15, 1944. Following the address, Mr. Davis invited discussion by those present. This discussion is printed here, following the text of Mr. Davis's address.

POSSIBLE ramifications of the subject of labor relations are very great. Because there is extensive experience to draw upon through a long history of employer-employee relations, I would advise any organization to make an extensive study of what has been done and what results have been forthcoming. Related activities, both in this country and abroad, cast light on the organization of professional workers and engineers, and on their relations with their fellow workers.

A volume on *Labor Relations in America* was published by the Twentieth Century Fund some years ago. This touched on the subject somewhat. In the maritime industry and in the railroad industry in this country the professional workers are organized—incorporated as a matter of fact, to some extent, with what might be called organizations of production workers, although in the maritime industry there is a pretty sharp division between supervisors and workers. Master mates and pilots, for instance, are held to be quite different from seamen.

In England there is a great deal of history of the organization of engineering groups. In Sweden there is some, although strangely enough until after the turn of the century there was a very definite and even bitter feeling in Sweden in opposition to the organization of professional workers. That was looked upon as disloyalty to the class; so much so that although they had had organizations of labor in Sweden for a decade at least, very highly developed, there was so much trouble when the professional workers came to organize that it was necessary to pass a law, modeled on our Wagner law. This law had practical application, however, only to white-collar workers because all the others were already organized. It asserted the legal right of the professional worker to organize and bargain collectively.

STATUS OF PROFESSIONALS

The professional worker and the engineer are likely to be in the middle, about halfway between the devil and the deep blue sea. The professional worker may in many cases be a part of management, or he may be the management, or he may not be a part of management at all—just an employee. Even in the last case his relations to the job, his professional obligations, his code of professional ethics, and even his economic status, are very different from those of the production worker. At one time, perhaps still, there was a disposition on the part of the professional worker to assume a position of impartiality between management and labor—and rest assured that any position in labor relations is better than trying to be impartial. Whatever he does, the professional worker should not do that, or he will find himself in the position of the impartial friend who tries to settle a family quarrel.

Engineers have their code of professional ethics. There is a certain individualism about it. It is a little hard to explain. I am a professional man myself. We lawyers have our code of professional ethics which we guard jealously. We think of it as an individual obligation and we seem to forget that it is a collective code. I did not write the code of legal ethics. It was written by my fellow lawyers. It is completely a collective code, and yet the individual lawyer has a feeling, if anyone assails it, of a personal responsibility. It has a personal touch, so to speak—so much so as to give rise to the thought, the illogical thought, I believe, that a professional code is incompatible with a collective labor agreement or with organization in a labor group. I don't think it is, as will be seen from what follows.

This conflict of ideas gives rise to many questions in the minds of interested people. Then too, the economic interests of the professional man and the laboring man are likely to be different. Also, if there is to be bargaining with the employer, the composition of the bargaining unit gives rise to difficult questions.

There is undoubtedly a disparity of interest between the professional worker and the production worker, although they have some interests in common. Certainly the professional worker has his code of professional ethics. He also has his living to make. He is interested in the economics of the situation just as much as the production worker—a little more so right now I think, since he is between the two pressures.

RECOGNITION OF PROFESSIONALS

The National Labor Relations Board has always recognized this disparity of interest. It spoke in one case of the interests of the technical, professional workers as being on a plane apart from the interests of the production workers, and in general its decisions have shown a marked tendency to separate the bargaining units wherever the professional worker evidences a desire to do so. Commonly, the National Labor Relations Board will, when the question arises, give the professional workers an opportunity to vote on whether they will go into the common unit or have a unit of their own.

A great deal of apathy on the part of professional workers has been evidenced—so much so that very little organization work on the part of one or more people, who are interested in having the professional workers incorporated in a larger unit, is very frequently effective in winning an election, because the majority of the professional workers do not vote.

In the construction industry, where the work is done almost completely by individual contractors who are largely engineers, the engineer is frequently the employer. Sometimes on the other hand he is just an employee, although he is more likely to be in a supervisory capacity than the ordinary production worker. Thus you have the questions that arise always when an effort is made to organize supervisory employees.

BASIC PRINCIPLES

Two basic principles seem to underlie the whole discussion. On one of them I am going to quote from my confrère, George Taylor, of the Wharton School of Business and Vice-Chairman of the War Labor Board, a man of very considerable wisdom in the field of labor relations. He said:

"Of all the major drives being made by the common man throughout the world for a better economic life, the drive for collective bargaining is the only one I know of that accepts the desirability of capitalistic economy, that accepts private ownership, the wage system, and the profit motive as the best means of producing goods." That is a very profound remark.

The collective bargaining system recognizes the responsibility and the right of management to manage. It is predicated on the free private economy theory. The system provides for the employees protection that cannot be denied them. The right to organize is a fundamental right, which in this country springs from the Bill of Rights. It is in the field of economics the right of freedom of assembly and freedom of speech, and it cannot be denied. The Wagner Act had to be passed to make sure that it would not be denied, but even before the passage of that act it was what lawyers call a common-law right. It is one of our inalienable rights.

The trouble with this right is that it has no limits in time or space, and the people who desire to organize can organize as broadly as they please. They can organize in one plant, and having done that they can extend the organization to another plant. They can organize throughout the entire nation, and there is no law to prevent them. The only offset or safeguard, in my judgment, is counter organization, the exercise of the same right by groups who have a different interest. At the same time that collective bargaining provides protection for that right, it also assures management protection of its prerogatives which are necessary to the operation of the plan.

THE RIGHT OF MANAGEMENT TO MANAGE

As George Taylor points out, in collective bargaining the workers do not fail to recognize the right of management to manage. There are cases where unwise labor leaders have attempted to encroach upon that right. There is the type of labor leader that is illustrated by Hardy in England, who believed in taking over the functions of management. It was that thinking in England which led to the great general strike of 1926 and put an end, I think, to general strikes in England for many generations. Ordinarily in collective bargaining there is no questioning of the right of management

to manage. The ordinary labor leader does not want to assume the obligations of management. Here, as in every other aspect of human life, there are questions of definition; there is a twilight zone where men disagree about whether a particular function is a function of management or a right of labor, but the principle is never really seriously attacked.

That is the first basic principle I want to emphasize—the character of collective bargaining. It is the most democratic approach toward the solution of the problems of group conflict that there is, and in this world of today, with all its disturbances, it seems to me to be a haven of refuge.

The other basic principle in that the only way this recognized right of both sides can be implemented effectively is by written contract, and that word "written" is particularly important. The right is recognized in theory, but for full protection, it must be put into the contract.

As an illustration, trouble began at an airplane plant that Henry Kaiser took over. There was a very serious difference about the plant guards. The contract was horrible, and there was a long history behind it of bad labor relations management. The immediate problem was whether the plant guards should take the assignments that were given to them by the naval officer in charge. The union contended that it had a right of seniority in whether John Jones would take a post on the front gate or the back gate, and that did not go very well with the naval officer. The solution was very simple. The WLB said, "Well, put it in the contract," and ordered them to write a contract as to the plant guards in which they recognized the right of the naval officer in the plant to make assignment of guards. There was no trouble in getting the union to sign it, and from that time on the guards made no trouble about the assignments. This illustrates the importance of a clearly written contract.

I believe strongly that the only way professional workers as a group can protect their group interest is by organization and written contract. Whether one likes it or not, that is the fact. An attitude of impartiality is of no use. Engineers can be impartial between the two groups, if they want to be, but they must be partial about their own interests. They must organize, in my judgment, and they must prepare written contracts.

Now, it may very well be that as the subject develops, it will be found wise for an organization of professional employees to have a contract also with the organized production employees. This is a very fertile field for examination. Such a contract should define the relationships between the two groups and keep both of them out of trouble. But certainly the professional employees should have a contract defining their relationships with the company.

The National Labor Relations Board has held that supervisory employees do not come within the provisions of the Wagner Act with respect to the setting up of bargaining units. Thus the Board has indicated that it will not designate a union of supervisory employees as the sole representative of a defined group of supervisory employees. In other words, the NLRB says, "We won't define the unit." The fact nevertheless remains that if there is an organization of supervisory employees that fact cannot be denied, nor can it be denied that the chosen representative of that group has the right to speak for the group.

The National Labor Relations Board has denied to supervisory employees the right, derived from the Wagner Act, of the majority to speak for the minority. This right exists only in America and Sweden. In England, for instance, there is nothing like that. The union is not the spokesman for the non-union men in the plant. They speak a good deal louder in most plants than the non-union men, but they don't speak for them. But here, under the Wagner Act, the majority becomes the spokesman for all, and the National Labor Relations Board has said that this does not apply to supervisory employees. That does not mean that supervisory employees are not entitled to organization, nor does it mean that an organization is not entitled to speak for its members.

There are undoubtedly great difficulties in defining the responsibility of the supervisory employee to management and to his fellow workers. Really, the futile thing, in my judgment, is to say "We won't recognize the existence of the organization or the right to organize." That is like sticking one's head in the sand. It won't do any good. There are real problems about the relation of supervisory employees to management and to their fellow workers, and the only way those problems can be solved is by collective bargaining and by defining the relationships involved in a contract. Until such definitions are put into the written contract, the relationships are a source of endless dispute. Professional people are quite likely to be in the position of supervisory employees in some capacity.

The disturbances, the questions, the difficulties that exist can only be solved by organization and by the making of written collective agreements. That is not always an easy thing to do. It takes brains, courage, reason, to work out these relationships, but they cannot be worked out by taking an individualistic position and saying that for some reason or other the engineer's code of professional ethics does not permit him to organize to assert his rights.

Dues Canceled on Request from Members in the Armed Forces

AT its October meeting in Denver, Colo., the Board of Direction of the Society passed the following resolution regarding cancellation of dues of members in the armed services:

"Cancellation of 1945 dues is hereby extended upon request to all those members of the Society in the armed services of the United States who are enlisted personnel and, upon application for such cancellation, to those commissioned officers receiving base pay of $2,400 or less. Those who receive this exemption will continue to be listed as members of the Society; and those who are Corporate Members shall retain their voting rights. However, no publications except CIVIL ENGINEERING are to be forwarded to those thus exempted."

Questions from the Floor

At this point Mr. Davis invited discussion from the floor. The questions asked and the answers given follow. Both questions and answers necessarily have been briefed to what appear to be the essentials.

QUESTION: When a unit appropriate for collective bargaining purposes is formed by engineers, does the unit have to be composed solely of engineering employees or may it include engineers who are employers?

ANSWER: The NLRB will recognize the legal status of an organization of professional employees, but in giving that organization a status as a bargaining unit, the Board will exclude from the unit all supervisory employees. For instance you might have, in a big company, an organization of chemists embracing all the chemists in the plant, including the head chemists. A bargaining unit could be formed from that organization by excluding the supervisory employees.

QUESTION: Does the National Labor Relations Act (Wagner Act) provide exemptions for the members of any professions?

ANSWER: No. The Wagner Act gives rights to all employees and the word "employee" in the act is defined broadly. It includes any employee, including supervisory employees. In regard to supervisory employees, the NLRB has held that they are entitled to protection against the unfair practices as defined in the Act. Nevertheless the NLRB will not define a unit composed solely of supervisory employees in which the majority will have the power to speak for all. One reason for this is, I think, that such a unit might be composed of classifications from Foreman up to President. In such a unit there would be many foremen and only one president, with the result that the foremen would outvote the president.

That situation reminds me of a famous remark of Corporal Tanner. The elders of us probably remember he was a Congressman from Tennessee who ran for office against a General in the Confederate Army. In a joint debate the General, who started the debate, put great stress on the fact that he was a General. Tanner got up and said "That is true, my friend was a General in the Confederate Army and a very fine one. We all honor him for it. As far as I am concerned, I was a private in the same army and my suggestion is that all the generals vote for him and all the privates vote for me."

QUESTION: How can collective bargaining be of use to municipal employees?

ANSWER: Frequently municipal employees are organized and

do really bargain collectively with department heads. Unfortunately the department head often does not have control over wages, hours, and working conditions, as they are generally fixed by statute.

QUESTION: Does the National Labor Relations Board have jurisdiction over salaries of municipal, county, and state employees?

ANSWER: No. Neither has the War Labor Board.

QUESTION: In your experience have you found any distinct antagonism between the production groups and the professional groups? I ask that in view of the fact that so many professional groups are close to management.

ANSWER: No, but that doesn't mean necessarily that there isn't antagonism. I can't remember any specific cases although undoubtedly if I made that remark to my confreres they would remind me of two or three cases.

QUESTION: Has Labor the tendency to associate the professional with management?

ANSWER: Many times the NLRB has been faced with the question of whether or not to include the professional workers with the production workers. You may remember the case in the Chrysler Plant. In that case the professional workers chose an independent unit by secret ballot. The policy of the C.I.O. is to create vertical organizations, including all employees. The A.F. of L. in general is inclined to have separate unions more along the lines of the traditional craft organizations.

QUESTION: What standing would a professional society like the American Society of Civil Engineers have in these matters as compared with a trade union group? How can a professional society protect the welfare and interests of its members as a trade union does?

ANSWER: Certain functions of a professional society have nothing to do with labor relations, and those functions should not be confused with the functions having to do with labor relations.

In England, for instance, the manufacturer's associations in each industry deal with trade problems alone, and have nothing to do with matters dealing with labor relations. So I think the Society might well devote itself to a study of the relations of its members as employees and as managers and advocate a general program. If such a study should lead to country-wide employee organizations in substantial quantity, then a central body might be warranted. It might be a committee, perhaps, of the professional society which would act as a central body for the country-wide bargaining units. Such a central committee must not be confused with the Society as such and it would be a great mistake to confuse the two bodies or to be vague or indefinite about them. They ought to be separated very distinctly, I think.

QUESTION: Assume that a professional and engineering society, composed of both engineer employers and employees, sponsors the formation of a collective bargaining group or groups composed of members and non-members of the society and maintains some control of these groups through financial support, through the requirement of an annual report, and perhaps by specifying that certain officers of the groups be members of the society. Would such groups have legal standing or would it be necessary that those groups be completely divorced from society control?

ANSWER: If you have in such a society, a group dealing with and assisting, if you please, organizations of employees, it surely ought to be a separate committee set up for that particular purpose and not confused with the general purposes of the society. You can't under the Wagner Act include a member of the society who is an employer in the same bargaining unit with a member of the society who is an employee because there is a real difference of viewpoint and even of interest between employer and employee. Even though employers and employees have many interests in common, it is very foolish to disregard those interests which are in conflict.

From a legal standpoint, a society having such an employee group or committee or separate entity, can legally assist any group of organized employees. There is no law against that. But the recognition by the NLRB and the making of a contract with the employer would have to be through the bargaining unit in the particular company or plant.

QUESTION: Then a professional society could act as a sponsor in getting collective bargaining units organized and, if the society felt that it was in the interest of its membership to do so, it could give those units funds from time to time in the form of gifts, but the society could maintain no voice in the control of those collective bargaining units and no employer member or supervisory employee could have anything to do with the policies or practices of those collective bargaining units?

ANSWER: I think that is correct. In addition, I think that a society, if it did something like that, might pass general resolutions as part of its code of ethics that engineering employees were to do so and so when entering into certain kinds of bargains.

QUESTION: In one case in a design office, over 100 men were employed. Of these 100 men, 20 or possibly 30 were professional employees. An election was held among the entire heterogeneous groups, the question being whether or not the majority wished to be represented by the CIO for purposes of collective bargaining. Even though the professional employees wished to be represented by a unit of their own, they were out-voted by the subprofessionals. The professional employees petitioned the NLRB for a separate unit, but a separate unit in this case was not granted. The CIO appeared before the NLRB with legal assistance and won the case. The professional employees in this case had no legal assistance. Could a professional society furnish such a group of professional employees with competent legal assistance?

ANSWER: The suggestion appeals to me tremendously.

QUESTION: Imagine an employee chemist in a large company. Can a collective bargaining unit composed of production workers speak for this professional chemist in matters pertaining to the conditions of his employment even though it may be against his will?

ANSWER: The individual chemist you are thinking about may have been included in a bargaining unit determined by the NLRB. A national union may have come in and asked for an election and asked for a definition of the bargaining unit. The bargaining unit may have been defined as all the employees in the plant below the level of supervisory employees. In that case the unit would include this chemist against his will. He may or may not have joined the union. He may or may not have voted in the election. If the majority included in the bargaining unit votes in favor of the unit, then it becomes the recognized bargaining agency for all including this chemist.

In general the NLRB applies the Globe Rule to the question of whether or not it will set up an independent unit in such a case and that rule is that unless the record shows some historical reason upon which it can define the unit from experience, then the NLRB will leave the choice of the unit to the employees. Members of any group asking for a separate unit will be given an opportunity to vote amongst themselves.

QUESTION: Assuming that the chemist in question can be submerged against his will in a heterogeneous bargaining unit, what effect does that have on him? Does it limit his working hours, for example, or can he put in as much time as he sees fit as much as his interest and his own desire dictates? Also does it prevent the employer from recognizing his individual initiative and ability and prevent the employer from remunerating him as he sees fit in accordance with his recognition of the man's individual ability?

ANSWER: Let's assume this chemist has been included in the bargaining unit for which the union speaks. A contract is negotiated. That contract will probably contain provisions as to working hours. Those provisions are usually minimum provisions. They do not prevent a chemist who loves his laboratory from sitting up all night in that laboratory even though his hours of work are usually fixed and standardized.

As to pay, let's assume that the contract fixes grades for chemists with a single rate for each grade. Then those rates are what the chemists get paid. If the company wants to promote this chemist to a higher grade, it can, but he still gets a grade rate. If for each grade there is a range of rates, then the company promotes within the grade at its own discretion. An individual starts in at the bottom of the grade and can be promoted to the top as rapidly as the company wishes. At least that was the case before the War Labor Board instituted the wage stabilization policy, which put certain limits on the rate of progression within a grade.

QUESTION: Assuming that there is a distinction between the professional worker and the professional man, in your judgment do you believe that collective bargaining is necessary for the professional man as distinguished from the professional worker?

ANSWER: A professional man has rights and interests economically which he shares whether he wants to or not with other professional men. Those rights and interests are not necessarily ident

al for each professional man, but they are similar. In my judgment, those rights and interests are in jeopardy today because of the great extension of organization of workers. The professional man has a right to organize and meet with his fellows if he wants to. My advice to him is he better get about it. He has the right to organize whether he is an employee or not. Naturally, if he is not an employee he can't bargain with his employer, but if he is an employee, and has fellow employees in the same profession, my advice to him is to organize.

QUESTION: Is it not true that this problem would be solved if we had a definite definition distinguishing the worker from the professional man?

ANSWER: That is very necessary. There is nothing so important as definitions. I don't mean definitions of words. I mean definitions of groups.

QUESTION: If a group of engineering employees wanted to bargain collectively and appealed to the National Labor Relations Board, would it or would it not have to say that it was backed by the American Society of Civil Engineers or some Local Section of the Society? Would such a group have to state by whom it was backed?

ANSWER: Such a group wouldn't have to say it was backed by anybody. The NLRB would ask if the group were composed of employees all within the same company; did it wish to set up a collective bargaining unit; did it represent the majority and how did it define the unit.

QUESTION: Suppose a small group goes before the National Labor Relations Board. Does such a group need legal assistance?

ANSWER: No. You don't need a lawyer. You can say to the NLRB, "Here, we have twenty men out of twenty-four (or whatever number it may be) who want to bargain collectively. How do we go about it?"

QUESTION: Does the National Labor Relations Board look with favor on independent unions? In the case of an independent union in a single company, can that union be represented by its own delegates independently of any association with any other labor group in the country?

ANSWER: Yes, there can be independent unions and those unions can be represented by their own delegates.

QUESTION: You have advocated that professional employees organize. What type of organization do you suggest or recommend? If the professional employees were to organize, would they be in a better position to organize through a professional society or through some outside organization like C.I.O. or A.F. of L.?

ANSWER: That is a very profound question and I don't know the answer. I was thinking of that problem when I said that I thought that if the professional men did organize, they would want to make contracts with the organizations of the production workers. My personal preference, perhaps biased by being a professional man, would certainly be for an organization of the engineers, separate from the production workers. There is an obvious difference between the two types of employees—different ways of thinking, different ambitions, and different economic interests.

QUESTION: Keeping in mind that some engineers by the nature of their employment are part of management and that others are a special type of employee, quite individualistic and not part of production, is it possible under the existing machinery to define this special type of employee and have it protected by a legal exclusion or act from the efforts of heterogeneous units to absorb it?

ANSWER: A good example of what you are talking about is found in the maritime industry, where there are master mates and pilots. In New York Harbor there may be many tugboats owned by different companies with only one master or mate on each one, yet all the masters and mates belong to the same organization. Of course they bargain separately with their different employers, but they have a strict definition of membership and definite rules. If I understand the type of engineer you are thinking of it is similar to the classification masters and mates. There might be only one or two of these engineers employed by each different employer and yet they could all belong to the same bargaining agency and that agency could bargain for the engineers, not necessarily through each employer but through an employer organization. That undoubtedly could be done.

QUESTION: Could the same basis of qualification for membership in the unit be used by engineers just as it is used by masters and mates, that is, the fact that a certificate has been issued by the Government?

ANSWER: Yes.

QUESTION: Can one who at some time is a professional worker and at another time is a production worker, step down, if he so elects, into the professional worker group?

ANSWER: Yes, it works both ways. He can be an employer at one time and at another an employee, and as the latter he can belong to a collective bargaining unit.

QUESTION: Would it be possible to take legal steps to have a federal law that would permit an organization of engineers containing employers and employees for the purpose of protecting the economic status of the engineer?

ANSWER: There are organizations today containing both employers and employees but should such an organization appear before the NLRB, that Board will define a unit excluding employers. The employers don't have to get out of such an organization but they are no longer represented by the union for the purposes of bargaining. In the matter of employment there is an essential conflict of interest between employer and employee and when they come together to bargain about wages and working conditions they should act separately.

QUESTION: Has the legal profession taken any steps toward providing for collective bargaining for its members?

ANSWER: Yes. The Lawyers Guild does concern itself to some extent with bargaining. That is, it backs up groups of lawyers employed by a big corporation, such for instance as a bank.

Technical Institutes to Be Accredited by E.C.P.D.

PLANS are under way for accrediting the curricula of technical institutes by the Engineers' Council for Professional Development, according to an announcement made by H. P. Hammond, M. Am. Soc. C.E., dean of the School of Engineering, Pennsylvania State College, who is chairman of the E.C.P.D.'s Subcommittee on Technical Institute Programs.

The general purpose of the accrediting program, according to Dean Hammond, is to raise the standards of instruction in the field of technical education intermediate between the engineering college on the one hand and secondary and vocational schools on the other, and to place this field of education on a basis of strength and usefulness comparable to the position it holds in other industrial nations. It is expected by this means to enhance the general status of technical and engineering education as a whole.

Additional personnel of the committee are as follows: C. W. Beese of Purdue University; George W. Case, Assoc. M. Am. Soc. C.E., of the U.S. Office of Education; John T. Faig, of the Ohio Mechanics Institute; L. J. Fletcher, of the Caterpillar Tractor Company; E. H. Rietzke, of the National Council of Technical Schools; and B. M. Woods, of the University of California.

Accreditation of curricula of engineering schools was undertaken by the Council many years ago and has resulted in the publication of lists of accredited curricula which are available for public reference. As only curricula leading to degrees in engineering were accredited, and the benefits of accreditation have been so marked, E.C.P.D. was asked to undertake a similar program for curricula of schools of the technical institute type. Authorization to embark on such a program was recently voted by the eight organizations which comprise the E.C.P.D. The Subcommittee on Technical Institute Programs was therefore organized to develop this program.

At the organization meeting of the subcommittee, held in Chicago, Ill., October 22, 1944, a statement of the basis for accrediting the curricula of technical institutes was adopted. This statement lists the general requirements which accredited curricula must satisfy, such as the length and nature of the curricula; requirements for admission; method of instruction; training, experience, and number of the teaching staff; type, financial stability, and achievements of the institution offering the curricula; and adequacy of the physical facilities.

Principles and procedures to be followed by the subcommittee are the following:

"1. Individual curricula are accredited.

"2. Rigid standards as a basis for accrediting are avoided in order to prevent imposed uniformity and to encourage educational experimentation.

"3. Curricula are appraised on invitation of the institution offering them.

"4. Curricula are accredited on the basis of both qualitative and quantitative criteria, which are evaluated through visits of inspection by a committee or committees representing E.C.P.D. and through data secured from catalogues, other publications, and questionnaires."

The subcommittee's statement makes it clear that any lists it publishes will include only curricula that have been accredited. It is planned that accrediting may be extended for a period of unlimited duration or may be made on a provisional basis for a limited period, with reappraisal at the end of that period. This procedure is the same as that which has been satisfactorily followed by the E.C.P.D. in accrediting engineering curricula.

In addition to the accrediting program, but only on request of recognized officials of an institution, informal advice will be given on matters such as changes in educational policy, organization, curricula, personnel, and physical facilities. It is further planned to reinspect curricula at intervals of three to five years in order to maintain the accredited list on a dependable and up-to-date basis.

President Pirnie Comments on Fees for Consulting Services

At its October 10 meeting, the Board of Direction adopted a resolution recommending suitable fees for consulting services. It will be found in the November issue, pages 482–483. Supplementing that condensed statement, President Pirnie has now prepared a few comments, as here given, to be considered as explanatory of the recommendation in the resolution.

A SOUND approach to consideration of proper compensation for consulting services to the Federal Government must be based on decision as to what will result in the best interests of the country.

Compensation for consulting services certainly should be commensurate with the services rendered—not just the amount of service, but the character and fundamental value of the service. Necessity for consulting services presupposes the existence of unusual, unfamiliar and difficult problems, the solution of which may be beyond the capacities of those individuals directly responsible for their solution, or perhaps of such nature as to raise questions in the minds of those responsible as to the adequacy of solutions they are proposing.

This statement will be confined to engineering problems, although it is quite true that the same general principles apply in other fields. Expert engineering advice may be required during the course of preliminary investigation, design, or during construction when difficult or unusual problems arise.

It is entirely proper to begin consideration of the matter by expressing recognition of the generally high qualifications of federal engineers. They are fully capable of coping with usual problems of investigation design, or construction. The mere fact that, from time to time, they find need for calling in consulting specialists is, of itself, recognition that the best talent obtainable is wanted. Such action is no reflection on anyone. It is recognition of the complexity of problems confronting the men concerned and recognition of the tremendous importance of balanced judgment in arriving at the best solutions of difficult situations. In such circumstances, the need is for engineers of recognized high ability, and long experience in fields embracing similar problems.

The design and construction of a dam on an important project may be cited as typical. A thorough understanding of meteorological and hydrological principles is a necessary requirement for proper preliminary study. Beyond that phase, sound treatment of the foundation for a dam is of utmost importance. Intimate knowledge of the characteristics of the subsurface materials to be encountered is essential. It is necessary to be able to predict what their behavior will be after they have been subjected to the loads to be imposed upon them. If natural conditions are not fully suitable, it is necessary to determine how much and what kind of treatment may be required. Integrity of the entire structure depends upon adequate foundation. Without adequate treatment, ultimate failure is inevitable. The result will be loss of money invested, and the probable loss of lives and destruction of property. The expenditure of $50,000 or $100,000 for consulting services which could readily mean the difference between a sound structure and a failure, is usually justified when the cost of a project runs into one or two millions. To a lesser degree, economies in design and in construction methods can return many fold the sums expended for adequate consulting advice.

It is obvious that engineers needed for consultation on important projects are men of unquestionable abilities who possess sound and mature judgment based on wide experience in their fields.

In a number of legislative Acts a maximum of $25.00 per diem, plus expenses, has been established for consulting services. There are eminently qualified engineers in full-time Government service who receive compensation at least equivalent to $25.00 per day as dependable, steady salary, together with such perquisites as sick leave, vacation time, retirement benefits, and the like.

Serving under their direction on the government payroll are assistant engineers, draftsmen, surveyors, and technicians who develop the studies and designs. Also available are adequate office personnel to handle correspondence and files for orderly classification of all records pertinent to all facts and experiences accumulated to form the fundamentals upon which engineering judgment of various problems must be based. All of these activities are carried on in offices furnished and equipped at government expense.

Consulting engineers in private practice must maintain, in general, similar offices, equipment, office personnel, assistant engineers, draftsmen, surveyors, and technicians and pay these aggregate costs entirely from the fees collected for their consulting services rendered as called for by their clients. Salaries and overhead needed to satisfy the peak demands of clients for services, continue through periods of less demand, when attention is directed to studies to advance knowledge in the profession that will be available to meet the future demands of clients.

Experience prior to the present world war demonstrated that the total fees received for engineering services by consultants in private practice were divided, on the approximate average of one-third to pay salaries of assistant engineers, one-third to pay overhead, and one-third to compensate the heads of an organization responsible for its financial and technological integrity. It was then generally recognized that the per diem charge for services of a consulting engineer of established ability in a specialized field should be at least one hundred and fifty dollars per day. Two-thirds of this charge paid salaries and overhead of his organization leaving only fifty dollars with which to meet contingencies inherent in future business and compensate him for his lifetime of effort in advancing knowledge in his chosen field of engineering service. Such engineers have served government for limited periods in the past at one hundred dollars per day, resulting in little if any personal compensation because they have believed our nation has first call upon the best each citizen has to offer.

It is not conceivable that the Congress would knowingly fix a limit on fees for consulting engineering services which is substantially less than the cost of providing them and thus require the engineer to make up his loss from charges made to industrial and local government clients. Therefore, it seems but just that future Federal legislation which establishes a maximum permissible rate of compensation for consulting engineering services specify a per diem rate of at least $100 in addition to expenses necessary for travel and subsistence.

MALCOLM PIRNIE
President, Am. Soc. C

"Transactions" in February

IT IS now possible to anticipate the distribution of the 19 TRANSACTIONS. From previous notices, it will be recalled that printing and binding has been seriously delayed because of lack paper. After several months of waiting, the necessary supp have been received and the work is going forward. Present pl are that Volume 109 for the year 1944 will be issued in its pap bound form with the February 1945 PROCEEDINGS as Part Cloth and leather-bound volumes will be issued separately and later dates.

It will be seen that the delay is about four months and compa with the interval of waiting for the paper supplies. The later is regretted and every effort is being made to expedite the is ance of this yearly volume.

News of Local Sections

Scheduled Meetings

CENTRAL ILLINOIS SECTION—Dinner meeting in the Urbana-Lincoln Hotel, Urbana, on January 22, at 6 p.m. (Speakers, Dr. K. Terzaghi and Dr. Wilbur M. Wilson.)

CINCINNATI SECTION—Meeting at the Engineering Societies Headquarters on January 24, at 8 p.m. (Speaker, W. R. Kellogg, city manager.)

CLEVELAND SECTION—Dinner meeting in the Hotel Cleveland on January 12, at 6:30 p.m.

COLORADO SECTION—Dinner meeting at the Edelweiss Restaurant on January 8, at 6:30 p.m.

CONNECTICUT SECTION—Dinner meeting at the Graduate Club on January 24, at 5:30 p.m. (Secretary Seabury and President-elect Stevens to be guests.)

DAYTON SECTION—Luncheon meeting at the Engineers' Club on January 15.

LOS ANGELES SECTION—Dinner meeting at the University Club on January 10, at 6:45 p.m.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on January 10, at 8 p.m.

MIAMI SECTION—Dinner meeting in the Wonder Grill on January 4, at 7 p.m.

MICHIGAN SECTION.—Dinner meeting at the University of Michigan on January 26, at 6:30 p.m.

NORTH CAROLINA SECTION—Annual meeting in the Sir Walter Hotel, Raleigh, on January 27, at 10:30 a.m.

NORTHEASTERN SECTION—Annual meeting in the Engineers' Club on January 22, at 6 p.m.

OKLAHOMA SECTION—Dinner meeting jointly with the Oklahoma Society of Professional Engineers in the Y.M.C.A. Bldg. Oklahoma City, on January 13, at 3 p.m.

PHILADELPHIA SECTION—Dinner and meeting in the Engineers' Club on January 9. Dinner at 6:30 p.m.; meeting at 7:30 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12 m.

SAN DIEGO SECTION—Dinner meeting in the U.S. Grant Hotel on January 25, at 6:30 p.m.

SAN FRANCISCO SECTION—Dinner meeting of the Junior Forum in the Engineers Club on January 25, at 5:45 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on January 22, at 12:15 p.m.

SEATTLE SECTION—Annual business dinner meeting in the Faculty Club on January 29, at 6 p.m.

SOUTH CAROLINA SECTION—Winter meeting in the Columbia Hotel on January 24, at 11:30 a.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Adolphus Hotel on February 5, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on January 8, at 12:15 p.m.

TRI-CITY SECTION—Dinner meeting at the Blackhawk Hotel on January 18, at 6:30 p.m.

Recent Activities

ARIZONA SECTION

A joint session with the Arizona Group of Professional Engineering Employees, on the evening of November 24, initiated the two-day annual meeting of the Arizona Section, which took place in Phoenix. The program was devoted to a discussion of collective bargaining, with Fred Guirey, president of the local bargaining group, the first speaker. Mr. Guirey discussed local aspects of the collective bargaining situation, after which H. L. Thackwell presented the national aspects of the problem. Mr. Thackwell is the Society's West Coast representative. A brief talk by the president of the Arizona Local of the A. F. of L., who was present by invitation, concluded the program. During the business session, held on the morning of the 25th, new officers were elected as follows: W. G. O'Harra, president; L. R. Dail, vice-president (for two years); and John A. Baumgartner, secretary-treasurer (for two years). George Grove will be serving the second year of his term as vice-president. Mr. Thackwell then spoke on "Sidelights of the Society," substituting at the last moment for Director A. M. Rawn, who had been scheduled to speak but found himself unable to be present; and E. V. Miller, engineer of plans and surveys for the State Highway Department, discussed the state's postwar highway plans.

The annual joint luncheon meeting with the Phoenix Chapter of the Arizona Association of Engineers was the next event, with Frank Hall, president of that group, presiding. Because of the enforced absence of L. M. Lawton, chairman of the International Boundary Commission, his paper, entitled "Water," was read by Gail Baker. Speakers at the afternoon session were E. A. Moritz, regional director of the U.S. Bureau of Reclamation (his paper on proposed diversions from the Colorado River to Arizona was read by Mr. Larson of the Bureau); Raymond A. Hill, former Director of the Society and Los Angeles consultant, whose subject was "The Function of the Engineer in Water Right Litigation"; and John Girand, Phoenix consultant, who discussed the status of the engineer in modern society.

BUFFALO SECTION

A talk by W. J. Conley, consulting engineer for the Lincoln Electric Company, comprised the technical program at the November 29th meeting of the Buffalo Section. Mr. Conley discussed the progress being made in structural welding, stating that welding is not a tool but a process and pointing out that it takes from one to ten years to make a good welder. Going into the mechanics of his subject, he explained that rounded corners are better than square because of a more uniform distribution of material, that greater penetration is obtained with a moving arc, and that it is cheaper and produces a better result to reduce thick castings to several thinner sections and then weld them together. Mr. Conley illustrated his talk with lantern slides.

CENTRAL OHIO SECTION

At the November meeting of the Section—held at Ohio State University on the 16th—Lewis G. Karrick spoke on the "Possibilities for Oil from Shale and Coal in Ohio." Mr. Karrick is research specialist for the Ohio State University Engineering Experiment Station. The Section's new officers, announced at this session, are as follows: C. W. Schoene, president; Nye Grant, first vice-president; G. E. Large, second vice-president; and C. C. Walker, secretary-treasurer.

CINCINNATI SECTION

On November 21 Harold W. Streeter, sanitary engineering director for the U.S. Public Health Service, discussed the subject of stream pollution and its control. Mr. Streeter, who has been in the Public Health Service since 1914 and is officer in charge of water and sanitation investigation at the Cincinnati Station, emphasized the national aspects of the stream-pollution problem as well as its relation to the local situation in the Ohio Valley. During the evening a certificate of life membership in the Society was presented to H. Lester Newhall, who gave a brief review of his thirty-five years in the profession.

CLEVELAND SECTION

"Electronics at Work" was the principal subject of discussion at the November meeting of the Section, the speaker being Carey Mann. In his talk Mr. Mann stated that "Electronics is a science that applies electronic tubes to the service of man." One of its most common uses is in connection with radio tubes, and it is important in high-frequency generation. Electronic tubes also make possible radar, one of the miracles of modern warfare. Another feature of the technical program was the showing of newly released motion pictures of the battles of Guam and Paris.

COLORADO SECTION

On November 13 members of the Colorado Section heard President-elect J. C. Stevens speak on "Sedimentation in Reservoirs." Mr. Stevens, who maintains a consulting practice in Portland, Ore., discussed the deposition of silt in Elephant Butte Reservoir, as indicated by surveys made at intervals since its completion in 1918, that reservoir probably being the only one in the world of any consequence for which such surveys have been made. Using the rates of deposition in Elephant Butte Reservoir as a gage, Mr. Stevens then made predictions as to the life of Lake Mead and other reservoirs that are proposed on the Colorado River.

CONNECTICUT SECTION

At a dinner meeting of the Section held on November 21, the Section awarded prizes of $10 each to John H. Fullerton, of the Yale University Student Chapter, and Shiro Alsawa, of the University of Connecticut Chapter. Following a business discussion, Robert J. Ross read a paper that he had written on the organization of a city engineer's office. Mr. Ross, who is city engineer-manager of the Hartford Bureau of Public Works, then outlined the improvements now nearing completion in the center of Hartford.

HAWAII SECTION

The Hawaii Section held its fourth dinner meeting of the year at the Pacific Club on November 6. The principal speaker was Beldon S. Tucker, chief of the Water and Sewage Division of the Central Pacific Base Command, who discussed "Army Sewerage in Hawaii." An animated open forum followed his talk. During the evening it was announced that the Junior Forum would be revived and would hold its first meeting later in the month.

IOWA SECTION

On November 17 members of the Iowa Section gathered at Des Moines for afternoon and evening sessions. The afternoon meeting was given over to business discussion and to the election of officers for 1945. These new officers are Frank Kerekes, president; Earle L. Waterman, vice-president; and L. O. Stewart, secretary-treasurer. During the dinner meeting that followed a certificate of life membership was presented to L. H. Mayne, who responded with a gracious talk. An illustrated talk on airport planning and development concluded the program. This was given by Paul Roberts, district engineer for the Civil Aeronautics Association.

KANSAS CITY SECTION

A talk by Malcom Pirnie, President of the Society, was the feature of a dinner meeting held on October 5. Mr. Pirnie gave an informative résumé of recent Society activities, reporting that the Society cooperated in the preparation of the Baruch Report. He pointed out, also, that the Society is stressing the need for competent engineering talent in the various administrative sections of the federal government, both in local problems and in formulating the peace and reconstruction to come. In closing, President Pirnie stated his belief that the immediate future holds the greatest opportunity of all time for the professional engineer, as well as the greatest responsibility.

KENTUCKY SECTION

Moving pictures provided the principal feature of entertainment at the October meeting of the Junior Forum of the Section. A colored film, entitled "Flood Control in the Wabash and Ohio River Valleys," gave an excellent idea of the earth levees, flood walls, and other protective devices. This was prepared by the Louisville District office of the U.S. Engineer Office. Showing of another picture, "The Case of the Ominous Arms," illustrating the menace of negligence in the plumbing trade, concluded the program. The latter film was made by the U.S. Public Health Service.

LEHIGH VALLEY SECTION

A symposium on flood control comprised the technical program at the November meeting of the Lehigh Valley Section. The scheduled speakers were Robert A. Harrier, managing director of the Lehigh Valley Flood Control Council, and C. F. Wicker, senior engineer in the Philadelphia District Office of the U.S. Engineer Office. Mr. Harrier reviewed the history and activities of the Lehigh Valley Flood Control Council from its inception and outlined the program of flood control that it has followed. Mr. Wicker's subject was present-day flood control problems in the Delaware River basin as applicable to the problems of the Lehigh Valley. The talks were of special interest as both speakers have been conducting engineering studies to determine the best methods of curbing the destructive floods in the Lehigh Valley.

LOS ANGELES SECTION

Following its annual custom, the Los Angeles Section celebrated "Ladies' Night" on November 8. There was an exceptionally large turnout to hear Col. Alexander R. Heron, director of the California State Reconstruction and Reemployment Commission, speak on "Planning Is Really Selling." Colonel Heron brought out vividly the fallacies of "made work" and pointed out that many millions will again be unemployed if something is not done to devise means of using them on productive work. An unusual program of vaudeville acts and other entertainment features brought the evening to a merry close.

LOUISIANA SECTION

During the October meeting of the Section—held in New Orleans on the 16th—it was announced that Section prizes of Junior membership in the Society have been awarded to James E. Hassinger, Tulane University alumnus, and Salvatore Moschella, member of the class of 1945 at Tulane. Erme B. Myott, lieutenant colonel, Corps of Engineers, U.S. Army, then spoke of his experiences on engineering work in Persia. Colonel Myott, who was recently granted the Legion of Merit Award for "exceptionally meritorious conduct in the performance of outstanding service with the Persian Gulf Service Command, was assigned to the Army Service Training Center at Camp Claiborne, La., following his overseas duties.

METROPOLITAN SECTION

The Junior Branch of the Metropolitan Section held a meeting on December 13, at which Col. Clarence E. Boesch spoke on "The U.S. Engineer Department in Civil Works." Colonel Boesch, who is head engineer of the North Atlantic Division of the Corps of Engineers, discussed in particular the present program of flood control in this area. Official War Department films, depicting combat activities of the Army Engineers, concluded the evening. The program presented at the November meeting of the Section is described elsewhere in this issue.

MICHIGAN SECTION

At the October 27th meeting of the Michigan Section the following new officers were elected: Clair C. Johnston, president; George W. McCordic, first vice-president; Chester L. Allen, second vice-president; and Thomas C. Hanson, secretary-treasurer. The principal speaker was Paul S. Reinecke, colonel, Corps of Engineers, U.S. Army, who discussed the effects of modern warfare on mapping. Colonel Reinecke described the use and manufacture of the various types of maps utilized by a modern army in the military campaigns. To illustrate his talk he showed examples of maps and projections, including the new fluorescent maps.

MID-MISSOURI SECTION

Senior-class members of the Chapter at the Missouri School of Mines were guests of the Section at its fall dinner meeting, which took place at Rolla on October 27. A talk by Dr. Edward Clark, state geologist for Missouri, comprised the technical program. Amplifying his subject, "The Postwar Position of the Geological Survey in the Field of Engineering," Dr. Clark outlined the research work his office is doing in the field of water resources, geology, and mapping, and emphasized the fact that at least one branch of his work is represented in practically every engineering project.

MID-SOUTH SECTION

The annual meeting of the Mid-South Section took the form of an all-day session, held in Vicksburg, Miss., on November 1[illegible]. During the morning session papers were presented by W. J. Turnbull, chief of the Embankment, Foundation, and Pavement Division of the U.S. Waterways Experiment Station, and W. K. Boyd, chief of the Flexible Pavement Branch of the Station. Following discussion of the papers, which dealt with the subject of pavement mixtures, the group recessed for luncheon, during which a motion

picture on the construction of Norfork Dam was presented by Capt. John L. Kemple, resident engineer on construction. Speakers for the afternoon session were W. L. Whittemore, of the U.S. Engineer Office at Little Rock, Ark., who discussed the design of Norfork Dam, and Capt. Joseph F. Friedkin, chief of the Potamology Section of the U.S. Waterways Experiment Station, whose subject was "Laboratory Study of the Elements of Meandering Streams." During the business session that followed the technical program, the following new officers were elected for the coming year: C. P. Lindner, president; Richard B. H. Shepherd, vice-president; and George L. Koomos, secretary-treasurer. The evening session was held jointly with the Engineers' Club of Vicksburg. Following the banquet, certificates of life membership were presented to LeRoy L. Hidinger, Harry N. Howe, Walter F. Schulz, Neal B. Garver, and William D. Dickinson. An interesting and entertaining talk, "Great Floods of History"—by Gerard H. Matthes, Honorary Member of the Society and director of the U.S. Waterways Experiment Station—concluded the program.

HUDSON-MOHAWK SECTION

During the annual meeting of the Section, which was held in Albany, N. Y., on November 14, new officers were elected for the coming year. These are as follows: G. Reed Shaw, president; Morris M. Cohn, vice-president; Frederick A. Smith, secretary; and Arvi O. Waananen, treasurer. The technical program consisted of a talk on sanitation, given by Morris M. Cohn, who is sanitary engineer for the city of Schenectady. Mr. Cohn pointed out that our postwar planning should give some consideration to health as well as to highways and housing. Health could be greatly improved, for instance, by postwar planning in the field of sanitary engineering.

OKLAHOMA SECTION

"Sanitary Engineering in Public Health" was the topic of discussion at the annual meeting of the Section, held in Tulsa on October 28. The principal speaker was Grover L. Morris, assistant engineer for the Oklahoma State Health Department; who stated that the part played by sanitary engineering in the work of protecting the public health is twofold. First, sanitary engineering principles are used to determine the effect of unsanitary conditions on the health of the people; second, these principles are used to correct the conditions efficiently and economically. The annual election of officers, held at this time, resulted in the selection of Frank C. Ames, as president; Leo Boswell, as first vice-president; and Hubert L. Hendrix, as second vice-president. J. E. Lothers will continue as secretary-treasurer for another year.

PHILADELPHIA SECTION

A large delegation of V-12 students from Swarthmore and Villanova attended the November 14th meeting of the Philadelphia Section. The program centered about the topic, "The Work of the Seabees," and the chairman of the evening was Comdr. Wilmer Z. Kline, Assistant Public Works Officer of the Fourth Naval District. The first scheduled speaker was Irvin S. Rasmusson, commander, Civil Engineering Corps, U. S. Naval Reserve, who had just returned from active duty in the Southwest Pacific. Commander Rasmusson described the work of the Seabees under the various conditions of war in the Pacific, and a 40-minute motion picture of Seabee activities supplemented his remarks. The list of guests included E. D. Graffin, captain, Civil Engineering Corps, U.S. Navy, who recently returned to Philadelphia as Public Works Officer of the Fourth District after many years of service in other parts of the world.

PITTSBURGH SECTION

The Pittsburgh Section held a joint meeting with the Engineers' Society of Western Pennsylvania on December 13. A talk by A. J. Boase on "Remarkable Developments in Reinforced Concrete Design and Construction in South America" comprised the technical program. Mr. Boase is manager of the structural bureau of the Portland Cement Association. R. S. Quick has been elected president for 1945, and F. S. Merrill, vice-president.

ROCHESTER SECTION

At the Section meeting held on November 16 the Aims, Activities, and Professional Objectives Committee presented a plan for the award of prizes for professional papers presented by members of the Section. First prize will consist of $25 in cash, with a certificate of honorable mention for the next best paper. The first award will be presented at the annual meeting of the Section in January 1946. The technical program consisted of a talk by Kenneth J. Knapp, city engineer of Rochester, whose subject was "Postwar Planning from the Viewpoint of the City Engineer."

SACRAMENTO SECTION

On November 21 Vice-President Franklin Thomas addressed the Section on present and future problems of the Society. Most important of these, he said, are those affecting the younger member—his education, economic status, and professional opportunity. He predicted that a greater part of the future engineer's education would be in the humanities. On November 28 Stanley Kerr, acting chief of the Division of Project Planning of the U.S. Bureau of Reclamation, gave an illustrated lecture on the social and industrial consequences of doubling the irrigable acreage in the Central Valley.

ST. LOUIS SECTION

The destiny of the Missouri Valley was discussed by Robert B. Brooks, St. Louis consultant, at the October meeting of the Section. Mr. Brooks stated that the foremost of the many problems involved is that of flood control, and made a strong appeal for the adoption of a plan to be carried out under the joint supervision of the U. S. Corps of Engineers and the Bureau of Reclamation instead of a superimposed control by a Missouri Valley Authority. It is his belief that these two government agencies are best fitted, by reason of past experience and accomplishment, to execute a workable plan.

SYRACUSE SECTION

The Syracuse Section celebrated its twenty-first year of existence with a meeting at the Syracuse Museum of Fine Arts on November 29. At the conclusion of the business discussion Lt. Col. John Elleman, district engineer for the Corps of Engineers, talked to the Section on the topic of military engineering, explaining some of the work of the Army Engineers and the Seabees. Portable gasoline lines and railroads were constructed in record time in order to supply the fast-moving Third Army. The lessons learned in France are now being employed in the Philippines, Colonel Elleman concluded.

VIRGINIA SECTION

The Virginia Section reports two joint meetings in the fall months. The first of these, a joint session with the Central Virginia Engineers' Club, took place on October 27 and was sponsored by the Section. This session was followed by a brief business meeting of the Section, at which the work of various committees was discussed. On November 17 there was a joint meeting with the Engineers' Club of Hampton Roads at Norfolk. The feature of the occasion was a talk entitled "Looking Ahead in Transportation," given by Warren White, of the Public Relations Department of the Seaboard Air Line Railway. Mr. White pinch-hit most successfully for Robert S. Henry, of the Association of American Railways, who had been scheduled to speak but was unavoidably detained at the last moment.

WEST VIRGINIA SECTION

Members of the Section met in Charleston on October 13 for afternoon and evening sessions. The speaker at the afternoon meeting was Col. Harry Pockras, district engineer for the U.S. Engineer Office at Huntington, who described the activities of the Engineer Office in war and peace. The election of officers, held at this time, resulted in the selection of G. L. Coyle, for president; E. M. Brown, for vice-president; and J. N. Wallace, for secretary-treasurer. Following a buffet supper, the group reassembled in the evening to hear William E. Wickenden, president of the Case School of Applied Science, speak on the importance of cooperation between the various engineering organizations. Speakers at a dinner meeting, held in Huntington on December 1, were F. S. Whitney, city engineer of Huntington, and Richard W. Amick. The latter has just returned from a tour of duty overseas as an American Red Cross field director, so had many interesting experiences to relate. During the evening certificates of life membership were presented to J. L. Richmond and H. S. Slocum.

ITEMS OF INTEREST

About Engineers and Engineering

Seabees Need Men

THERE IS an immediate need for several hundred men with civil engineering degrees to serve in the Construction Battalion, or Seabees as it is more popularly called. These men should be between the ages of 19 and 38, although there are several billets for exceptionally well-qualified men between the ages of 38 and 50. In some cases, minor physical defects will be waived. The duty will be performed outside the continental limits of the United States, and consists in heavy construction and field work in building barracks, hangars, airfields, roads, piers, etc. It is unnecessary for me to point out that this program is urgent and the need is immediate.

Those interested should write for further information to any of the following Naval Officer Procurement Offices or apply there in person:

California—703 Market St., San Francisco, or 411 West Fifth St., Los Angeles
District of Columbia—1320 "G" St., N.W., Washington, D.C.
Georgia—721 Healey Bldg., Atlanta
Illinois—141 W. Jackson Blvd., Chicago
Louisiana—611 Gravier St., New Orleans
Massachusetts—150 Causeway St., Boston
Michigan—1249 Washington Blvd., Detroit
Minnesota—Northwestern Bank Bldg., Minneapolis
Missouri—1009 Baltimore Ave., Kansas City
New York—33 Pine St., New York
Ohio—617 Vine St., Cincinnati
Pennsylvania—Widener Bldg., Juniper & Chestnut Sts., Philadelphia
Texas—Niels Esperson Bldg., Houston
Virginia—Fifth and Cary Sts., Richmond
Washington—117 Marion St., Seattle

Data on Postwar Planning

SIGNING by the President of the "War Mobilization and Reconversion Act of 1944" has been followed by a marked increase in requests to the Federal Works Agency for information regarding postwar public works and postwar planning. The Act authorized the Federal Works Administrator to make loans or advances to the states, their agencies and political subdivisions, and to aid in financing the cost of studies, surveys, and plans "and other action preliminary to the construction of public works."

To help meet this need for information, excerpts from addresses and statements by Maj. Gen. Philip B. Fleming, Federal Works Administrator, before various organizations and Congressional committees have been assembled in a pamphlet entitled "Postwar Public Works." This contains General Fleming's views on a postwar construction program that will help stabilize employment while private industry gets back to a peacetime basis.

Copies of the pamphlet may be obtained by newspapers, trade publications, and officials of towns, cities, counties and states, on request to the Federal Works Agency, Washington, D.C.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

THE JANUARY meeting of the Engineers Club was delayed by the cigarette deficiency. The few who had lighted pipes leaned back to tease the others struggling with the makings. For every fag that was rolled to specifications there were three lean ones the shape of matches and five plump ones the shape of duck pins. The Professor's "duck pin" failed in bond and disintegrated into his demitasse; ruefully he laughed with the crowd.

"I walked a mile and there wasn't any camel," he explained. "I'll roll another while Guest Professor Bray proves that a man can catch his shadow quicker than a cigarette."

"I'll prove it your way, Noah, letting Joe Kerr give the wrong answer and Cal Klater the right one. Well, Joe?"

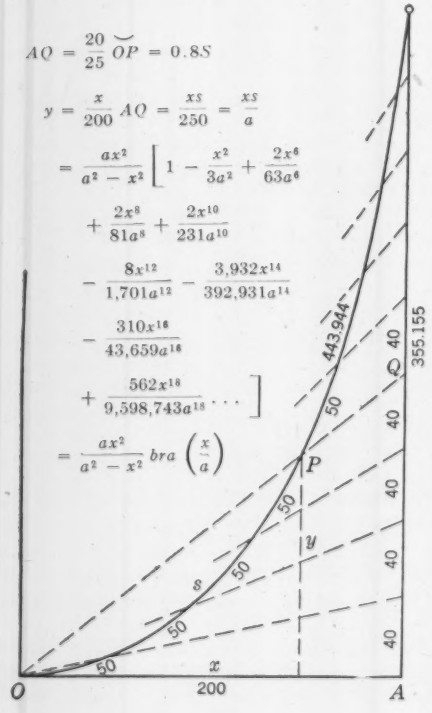
"Mine's right this time, thanks to this graph. I marked off AQ, the east wall, in 40-ft. steps, showing where the shadow was every 2 sec. The runner had to be on the line between the light and his shadow, so I drew rays from O to the points on AQ. In 2 sec, the chap ran 50 ft, so I set my dividers at 50 and stepped from O to one ray after another until I came to the east wall 354 ft from A. Neglecting the small difference between arc and chord, the shadow was caught in 17.7 sec."

$$AQ = \frac{20}{25}\overset{\frown}{OP} = 0.8S$$

$$y = \frac{x}{200}AQ = \frac{xS}{250} = \frac{xS}{a}$$

$$= \frac{ax^2}{a^2 - x^2}\left[1 - \frac{x^2}{3a^2} + \frac{2x^6}{63a^6} + \frac{2x^8}{81a^8} + \frac{2x^{10}}{231a^{10}} - \frac{8x^{12}}{1{,}701a^{12}} - \frac{3{,}932x^{14}}{392{,}931a^{14}} - \frac{310x^{16}}{43{,}659a^{16}} + \frac{562x^{18}}{9{,}598{,}743a^{18}} \cdots\right]$$

$$= \frac{ax^2}{a^2 - x^2}\, bra\left(\frac{x}{a}\right)$$



"Right, Joe, but not right enuf. Your turn, Cal."

"Not here," ventured Ken Bridgewater. "He set up the simple equation, $250y = xs$, where s is the length of the curve from origin to (x, y). That led him to the differential equation:

$$x(a^2 - x^2)dy = (a^2y \pm x\sqrt{a^2y^2 + a^2x^2 - x^4}$$

where $a = 250$. He's been playing with that for a month!"

"So did I, Ken, but the second month brot me a series solution which I'll write on the board (Fig. 1). Beside the part just drew, the whole curve is symmetrical about the Y axis, making a big U between the asymptotes $x = \pm a$. So the chap caught his shadow in 17.758 sec. Do you check me, Noah?"

"On the nose, Al, and thanks. I'd suggest one simplification, tho. The power series is a transcendental that deserves a name, such as the Bray Function. Then you can let $z = x/a$ and write

$$y(1 - z^2) = az^2\ bra\ z$$

"When my foreign correspondent, Alexander de l'Axe, complained that he couldn't locate the advance missions he covered, we contrived our "pendulum code." In preparation, that last night on the deck at San Francisco, we calibrated his pluming bob as a seconds pendulum. Xmas day I wrote a letter containing this paragraph:

"Yesterday, as agreed, I borrowed a transit tripod, set up the bob over the hub and waited until the shadow of the cord split a peg 2ft. of the hub. Holding the bob over the peg I released it, looked at my watch and started counting. Just 24 hr later, I caught the bob over the peg at the end of its 86,352nd swing. The noon signal from Greenwich came over the radio at the 28,424th swing."

"The censors passed it, so you'll have to look closer than they did. Where was de l'Axe on Xmas?"

[Professor Al G. Bray, previously identified as Allen H. Brownfield, offers another month to Cal Klaters. The pendulum problem was suggested by correspondence with Arthur L. Elliott.]

Positions Open in Detroit

THE DETROIT Civil Service Commission announces opportunities for Civil Engineers and City Planners in its various operating and planning divisions. The positions have induction salaries ranging from $2,400 to $4,830 per year, based on a 40-hour week. Also, time and one-half is paid, up to a limit of $1,000 per year, for work on the sixth consecutive day.

Residence rules have been waived. Applications, and examinations are held

...ily in Detroit or may be arranged in localities convenient to the applicant.

Qualifications for successful applicants include education and experience equivalent to that customarily recognized as the professional standards at the various levels. Application information may be obtained from the Detroit Civil Service Commission, 735 Randolph Street, Detroit 26, Mich. The City of Detroit adheres to the Employment Stabilization Plan of the War Manpower Commission for the Detroit area.

James Stewart and Company Celebrates Centennial

FEW construction concerns have adjusted their methods to changing times so well that the organization has survived—indeed continued to expand—for as long as a hundred years. Therefore the resourcefulness and versatility of James Stewart and Company which has enabled it to enter into a second century of construction—doing a larger volume of work than ever before—is worthy of note.

At a recent anniversary celebration held in New York City, a remarkably well done record of the accomplishments of this concern was distributed. In this volume, profusely illustrated, are listed an amazing number of structures erected. They range from monumental government buildings in Washington, D.C., to grain elevators in Russia, and commercial buildings in Japan.

Actually the book is a tribute to the workmen, their supervisors, and the officers of the company whose enterprise has contributed enormously to our way of life. The factories, hotels, commercial buildings, and great variety of other facilities erected by this one company would, if brought together, constitute a great city.

Guide to Federal Agencies Available

ALTHOUGH not originally intended to help the business man find his way around the Capital's bureaus, the recent publication of the Citizens National Committee, Inc., of Washington, D.C., called "Federal Agencies," comes close to being a government guide book. Actually, this "descriptive tabulation of 428 functional units of the federal government," provides the name, a description of the function, the method and year of creation, and the appropriation and estimated average personnel for each of the agencies listed as of June 30, 1944.

To complete the book's usability, an elaborate cross-indexing of listings has been provided, giving official names and a listing by the key word in each name as well. Thus if you are not sure whether the unit you're hunting for is one of the "Bureaus," "Offices of," or "Nationals," you can still locate it without delay.

The price of this handbook is 25 cents, and copies may be obtained from the Citizens National Committee, Inc., 1409 L Street, N.W., Washington, 5, D.C.

NEWS OF ENGINEERS

Personal Items About Society Members

S. O. HARPER announces that he is retiring as chief engineer of the U. S. Bureau of Reclamation in Denver, Colo., after thirty-seven years with that organization, though he will continue to serve the Bureau in an occasional consulting capacity. Mr. Harper, who was appointed chief engineer in July 1940, has directed the construction of Grand Coulee and Shasta dams as well as many of the other notable structures built by the Bureau. He will make his home in the San Francisco Bay region. WALKER R. YOUNG, assistant chief engineer, has been appointed acting chief engineer.

DANIEL W. MEAD, Past-President and Honorary Member of the Society, was presented with a certificate of honorary membership in the Western Society of Engineers at the seventy-fifth anniversary meeting of that organization, which took place in Chicago on December 5. An advance note of this award appeared in the March 1944 issue of CIVIL ENGINEERING.

L. J. SVERDRUP, who was recently promoted from the rank of colonel in the Corps of Engineers, U.S. Army, to that of brigadier general, is now chief engineer with General MacArthur's Expeditionary Forces. Before entering the Armed Services, General Sverdrup was a partner in the St. Louis consulting firm of Sverdrup and Parcel.

RAYMOND ARCHIBALD has been appointed chief of the bridge division of the Public Roads Administration. He has been with the Administration since 1935, his most recent assignment having been on the design and construction of bridges on the Alaska Highway.

J. T. L. MCNEW who has been on military leave of absence from the Agricultural and Mechanical College of Texas, has returned to that institution to fill the newly created post of vice-president of engineering. He has been serving in the Corps of Engineers, U.S. Army, China-India-Burma theater of operations, having the rank of lieutenant colonel.

BOYNTON J. FLETCHER is chief engineer of the New Kensington (Pa.) branch of the Aluminum Company of America. He was formerly an engineer in the Service Development Division of the company.

HAROLD F. HAMMOND has resigned as director of the traffic division of the National Conservation Bureau, accident-prevention division of the Association of Casualty and Surety Executives, in order to accept an appointment as manager of the Washington Office of the American Transit Association. While Mr. Hammond was with the National Conservation Bureau, his headquarters were in New York.

BRENT O. LARSON is now a major in the Corps of Engineers, U.S. Army, the rank representing a promotion from that of captain. Major Larson has been assigned to Y-force, the American liaison organization that trains and supplies the Chinese Expeditionary Force for certain campaigns.

W. L. VOORDUIN has severed his connection with the Tennessee Valley Authority in order to accept an appointment as executive member of a newly formed Central Technical Power Board of India. His initial appointment is for a three-year period, and he will be in charge of hydroelectric power on the board. Mr. Voorduin has been with the TVA for the past ten years—most recently as head of the Project Planning Division, Water Control Planning Department. He will be succeeded in the latter capacity by GEORGE K. LEONARD, former project manager of the Hiwassee Project. Other changes in the TVA personnel include the resignation of EMORY W. LANE, who has been in the Water Control Planning Department at Knoxville. Mr. Lane will resume his engineering teaching position at the University of Iowa.

WILLIAM R. CHRISTMAN, a private in the U.S. Army, is at present serving in the communications section of a headquarters group of Y-forces in western Yunnan. Until lately he was stationed at Fort Belvoir, Va.

JOSEPH K. BLACK, previously project manager for the TVA on the Fort Loudoun Project, has gone to Brazil, where he will be construction manager for the Electric Bond and Share Corporation. He will be located in Rio de Janeiro.

WILBUR R. BARROWS, lieutenant, Civil Engineering Corps, U.S. Naval Reserve, has been decorated with the Bronze Star Medal for heroism in the invasion of Normandy. According to the citation accompanying his award, he ". . . beached two waves of ferries under air attacks and shellfire, established unloading contacts, and directed the maintenance of the ferries so successfully that they were able to maintain a high efficiency during the critical period."

WALTER HOVEY HILL, member of the Advisory Mining Committee of the Idaho State Planning Board, Grangeville, Idaho, was "drafted" to run for the position of county probate judge in the recent elections and was unanimously elected.

ROBERT L. JEANS recently resigned as principal engineer for the War Production Board in Washington, D.C., in order to accept a position with the Westinghouse International Company.

CLARENCE E. SEAGE, consulting engineer of San Francisco, Calif., has been serving as consultant on an industrial planning survey for the city of Portland, Ore.

GEORGE D. WHITMORE, chief of surveys, Maps and Surveys Division of the TVA, Chattanooga, Tenn., is in Brazil at the request of the Brazilian Government to advise them on mapping methods and procedures.

HENRY J. BRUNNIER, consulting structural engineer of San Francisco, Calif., was elected president of the American

Automobile Association at the recent annual meeting of the organization.

WILHELM D. STYER, has been promoted from the rank of major general in the Corps of Engineers, U.S. Army, to that of lieutenant general. Since May 1943 General Styer has been chief of staff and deputy to the commanding general of the Army Service Forces. Other recent promotions in the Corps of Engineers include that of HARRY B. VAUGHAN, commanding general, Services of Supply, Western base section, European theater of operations, from brigadier general to major general.

HARRY W. LOVING, of Charlotte, N.C., was recently awarded the emblem for Exceptional Civilian Service in his capacity as head of the Price Adjustment Branch, Readjustment Division, Office of the Chief of Engineers. In presenting the award, Maj. Gen. Eugene Reybold, Chief of Engineers, called attention to Mr. Loving's exceptional service to the War Department in directing the negotiation of construction and supply contracts, and pointed out that he has "contributed substantially to the Nation's war effort" by accelerating the manufacture of facilities and the production of armament. Mr. Loving has been with the War Department since July 1940.

WINFRED D. GERBER announces that he is retiring after sixteen years of service as engineer for the Illinois State Water Survey at the University of Illinois. Before assuming his post at the University Mr. Gerber had spent over thirty years with railroad and industrial organizations.

HOMER B. PETTIT, colonel, Corps of Engineers, U.S. Army, has been assigned to duty as district engineer for the Boston district of the U.S. Engineer Office. Until lately Colonel Pettit has been commanding officer of the desert district in the Persian Gulf Command.

THOMAS H. MACDONALD, Honorary Member of the Society, was honored at the thirtieth annual meeting of the American Association of State Highway Officials—held in Cincinnati, Ohio, November 27 to 30—with a special certificate in recognition of his twenty-five years of service as head of the federal road agencies. Another Society member honored during the meeting was CHARLES A. PURCELL, director of public works of California, who received the George S. Bartlett Award.

T. H. SANDERSON has been promoted from the position of superintendent of quality control for the Carnegie-Illinois Steel Corporation to that of division superintendent of the organization's armorplate division at the Gary (Ind.) works.

HERMAN H. JOST, JR., captain, Field Artillery, U.S. Army, has been awarded the Silver Star for three months on one of the "most hazardous jobs in the field artillery," that of liaison officer with the infantry. Captain Jost, who already holds the Bronze Star for gallantry, is with General Patton's army. Before joining the army in 1942 he was hydraulic engineer with the Union Electric Company in St. Louis.

GORDON L. BURT, formerly instructor in civil engineering at Rose Polytechnic Institute and more recently stress analyst for Consolidated Vultee Aircraft Corporation, has been appointed a first lieutenant in the Sanitary Corps of the U.S. Army and ordered to active duty at the Presidio of San Francisco.

FRANK J. ROSSI was recently elected vice-president of the Northern California section of the American Association of Engineers, and also a director of the League of California Cities, to serve for two years. Mr. Rossi is city engineer of Modesto, Calif.

HAROLD B. GOTAAS, lieutenant colonel, Sanitary Corps, U.S. Army, has been appointed director of the Division of Health and Sanitation of the Institute of Inter-American Affairs and vice-president of the Institute. He was formerly chief engineer and assistant director of the Division.

DECEASED

HOWARD MILTON BROADMAN (Jun. '41) engineer for the H.R.H. Construction Corporation at Cheektowaga, N.Y., died on April 29, 1944, at the age of 25. An alumnus of the Newark College of Engineering, class of 1941, Mr. Broadman became connected with the New York office of the H.R.H. Construction Corporation shortly after his graduation. His home was in North Bergen, N.J.

CHARLES BARTO BROWN (Assoc. M. '14) assistant secretary of the Connecticut Savings Bank, New Haven, Conn., died on November 2, 1944. Mr. Brown, who was 71, had specialized in banking and statistics since 1919. Earlier in his career he was professor of civil engineering at the University of Maine.

WILLIAM HARRY VICTOR CORNEY (Assoc. M. '37) senior engineering surveyor for the South Australian Government, Adelaide, South Australia, died recently. Mr. Corney, who was 50, was born in England but spent his entire career in Australia. Except for a two-year period he was with the Government of South Australia from 1912 until his death—since 1931 as engineering surveyor in the Engineering and Water Supply department.

DAVID WILSON CROFOOT (Assoc. M. '32) first lieutenant, Corps of Engineers, U.S. Army, died on September 20, 1944, of wounds received while in action in the Pacific. His age was 42. Mr. Crofoot received the A.B. degree from Cornell University in 1923, and spent the following year in graduate work in civil engineering there. From 1925 to 1929 he was with the Alabama State Highway Department, and from 1929 to 1943 with the Missouri State Highway Department—since 1930 in the capacity of project engineer.

WILLIAM ROBERT DUNN (M. '25) of Denville, N.J., died recently at the age of 84. Mr. Dunn spent most of his career with the Vulcanite Portland Cement Company, of Philadelphia, Pa., serving successively as superintendent of installation and construction, works manager, manufacturing director, and assistant to the president. He retired in 1931, but continued on the Board of Directors. Mr. Dunn was the inventor of a fuel-feeding device and bag-filling and weighing machine in wide use both here and abroad.

OZRO NOWLIN FLOYD (M. '21) consulting engineer of Dallas, Tex., died suddenly at his home in that city on November 30, 1944. He was 66. From 1913 to 1922 Mr. Floyd was with the Miami Conservancy District, and from 1922 to 1925 he was assistant chief engineer for the Wichita Falls Irrigation District. From 1925 on he was in private practice in Dallas—until 1935 as a member of the firm of Floyd and Lochridge. An authority on earth-work dams, he had been a member of the Board of Consulting Engineers for the TVA since 1934 and has acted as consultant to the Corps of Engineers, U.S. Army, on the construction of a number of dams. Major structures on which he served as consultant include Madden Dam in the Canal Zone and Denison Dam in Texas.

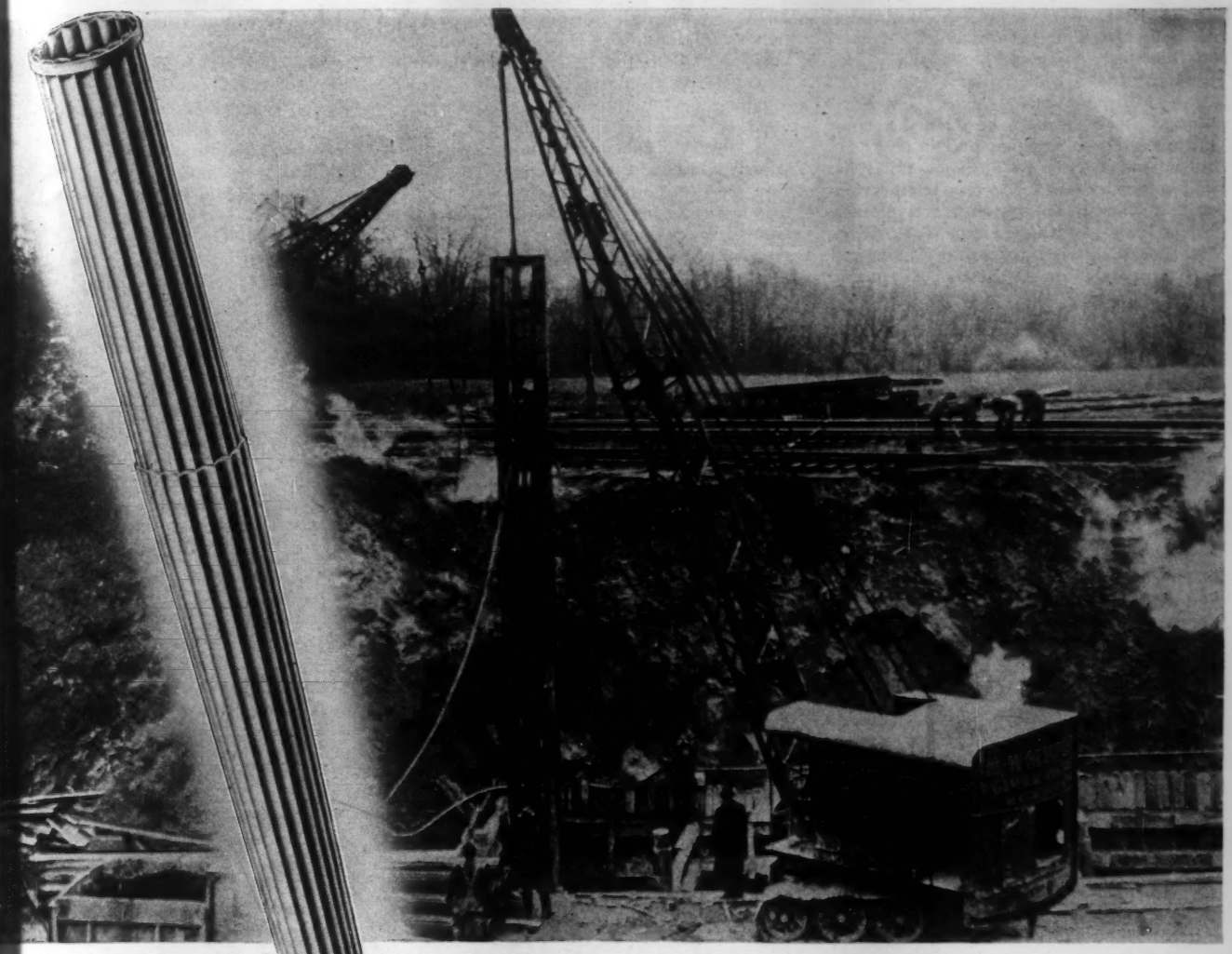
JOHN FRANCIS FRIEBELE (M. '20) president of the Karno-Smith Company, of Trenton, N.J., died on September 1944. Mr. Friebele, who was 64, had been with Karno-Smith, engineers and contractors, since 1920—in the capacity of president for most of this period. Earlier in his career (1906 to 1909) he was estimator and designer for the J. B. and J. M. Cornell Company, of New York City, and from 1910 to 1920 structural engineer for the John W. Ferguson Company, of Paterson, N.J., in charge of the estimating and design of industrial buildings.

ALONZO JOHN HAMMOND (M. '04) Past President and Honorary Member of the Society, died suddenly in Washington, D. C., on December 1, 1944, at the age of 75. A brief biography of Mr. Hammond appears in the "Society Affairs" section of this issue.

CLINTON LEE HARRIS (M. '36) professor of architectural engineering at Pennsylvania State College, died at his home in State College, Pa., on November 15, 1944. He was 58. Professor Harris had spent his entire career at Pennsylvania State College, having gone there as instructor in engineering drawing in 1913—he had been professor of architectural engineering since 1926. He had made studies of wind pressure on tall buildings and was the author of a well-known text on the subject. He was, also, associate author of a college publication, *Building or Buying a Home*.

PHILIP JOSEPH KEALY (M. '42) chairman of the Board of Supervising Engineers, Chicago, Ill., died on August 1944. His age was 60. From 1910 to 1914 Mr. Kealy was with Bion J. Arnold of Chicago, on electric valuation work, and from 1915 to 1920 president of the Kansas City Railways Company. From 1921 to 1928 he maintained a consulting practice in Kansas City, and from the latter year to 1934 was president of the Paving Service Company, Chicago. Since then he had been connected with the Chicago Board of Supervising Engineers in the capacity of chairman for the past two years.

WINFIELD SCOTT KING (M. '99) civil engineer of Tucson, Ariz., died on Nove



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ber 15, 1944, at the age of 82. Beginning in 1889, Mr. King became chief engineer on the construction of the Omaha stockyards, and later did similar work in St. Paul, Minn., Lincoln, Nebr., and Fort Worth, Tex. In 1915 he opened a consulting office in Omaha, and in 1920 he moved his practice to Tucson. Later he was associated with the city engineering office in Tucson, retiring from active practice in 1930. During the first World War, Mr. King served in the Corps of Engineers, U.S. Army, attaining the rank of captain.

ALFRED EPHRAIM KORNFELD (Affiliate '08) retired engineering publisher, of New York City, died there in April 1944, though the Society has just heard of his death. Mr. Kornfeld, who was 74, was manager and vice-president of the Engineering News Publishing Company from 1892 to 1911. He then became connected with *Engineering News-Record*, retiring some years ago.

JOHN ROBERT LAMBERT (M. '24) chief engineer and general manager of the Phoenix Iron Company, Phoenixville, Pa., died in a hospital there on November 12, 1944. He was 60. Mr. Lambert spent most of his life in Phoenixville, having gone there in 1906 to take a position with the Phoenix Bridge Company. In 1927 he was made chief engineer and, following a reorganization of the company in March 1944, he had been chief engineer and general manager of the Phoenix Iron Company.

ROBERT AUGUSTUS LEWIS (Jun. '42) first lieutenant, Infantry Reserve, U.S. Army, was killed in action in Germany on September 20, 1944. Mr. Lewis, who was 23, graduated from Virginia Military Institute in 1942, receiving the degree of B.S. in C.E.

GEORGE RAYMOND METZGER, JR. (Jun. '35) captain, Corps of Engineers, U.S. Army, died in France on September 21, 1944. He was 32. Born in Buffalo, N.Y., he was an alumnus of Dartmouth College, class of 1933, and in 1935 received the degree of C.E. from the Thayer School of Engineering. Before joining the Army in 1942, Captain Metzger had been with the U.S. Engineer Office in Buffalo; assistant superintendent for the Metzger Construction Corporation, of Buffalo; and property inspector for the Prudential Insurance Company of America.

DAVID LEONARD NEUMAN (M. '36) colonel, Corps of Engineers, U.S. Army, Columbus, Ohio, was fatally stricken in Marion, Ohio, on November 24, 1944, while on a military assignment. Colonel Neuman, who was 54, served as an officer in France in the first World War and had been in the Corps of Engineers, U.S. Army, ever since. He had been stationed in the Canal Zone, at Fort Leavenworth, Kans., and at Fort Belvoir, Va. About two years ago he attained the rank of colonel and was transferred to Columbus. One of his more recent assignments was on the construction of the Alaskan Highway.

HENRY LINTON REBER (M. '04) consulting engineer of St. Louis, Mo., died on November 1, 1944, at the age of 74. Mr. Reber's early career was spent with various public utility companies. Beginning in 1900, he was for many years connected with the Kinloch Telephone Company, of St. Louis—successively, as secretary, chief engineer, general manager, and president. For the past twenty years he had maintained a consulting practice in St. Louis.

WILLIAM POWELL ROTHROCK (M. '13) colonel, Corps of Engineers, U.S. Army (retired), State College, Pa., died on November 8, 1944, at the age of 76. From 1900 to 1916 Colonel Rothrock was with the Fort Pitt Bridge Works, of Pittsburgh. During this period he was superintendent and chief of construction on many notable projects, including bridges across the Monongahela, Ohio, and [illegible] lem rivers. He served, successively, captain and major in the Quartermas[illegible] Corps of the U.S. Army during the [illegible] World War, directing construction [illegible] Camp Logan at Houston, Tex., and of [illegible] three large helium plants at Petrolia, T[illegible] Honorably discharged in August 1919, [illegible] was commissioned a lieutenant colo[illegible] in the U.S. Army Reserve in 1920 [illegible] colonel in 1930. Following the war, [illegible] was engaged on the design and constr[illegible] tion of sugar mills and facilities in Cu[illegible] In 1924 he went to live at State Colle[illegible] serving occasionally in a consulting [illegible] pacity.

MILTON HARRY SCHOERPNER (Jun. [illegible] private, Corps of Engineers, U.S. Ar[illegible] was killed in action in France on Septe[illegible] ber 12, 1944. He was 27. Following [illegible] graduation from New York University [illegible] 1942, Mr. Schoerpner was employed fo[illegible] time as junior hydraulic engineer for [illegible] U.S. Geological Survey in Albany, N.Y.

PETER GANSEVOORT TEN EYCK (M. [illegible] retired engineer of Albany, N.Y., died [illegible] September 2, 1944, at the age of 71. Ea[illegible] in his career (1897 to 1905) Mr. T[illegible] Eyck was with the New York Cen[illegible] Lines, and from 1905 to 1908 with [illegible] Federal Railway Signal Company. La[illegible] he was for some years chairman of [illegible] Albany Port District Commission, di[illegible] tor of several railroads, and chairman [illegible] the New York State Advisory Board [illegible] der the Federal Emergency Adminis[illegible] tion of Public Works. Long active [illegible] public service, Mr. Ten Eyck served i[illegible] terms as U.S. Congressman—from 191[illegible] 1915 and from 1921 to 1923.

JOSEPH L. VILL (Jun. '43) first li[illegible] tenant, Infantry, U.S. Army, was ki[illegible] in action in France on June 7, 1944. M[illegible] Vill, who was 24, graduated from Dre[illegible] Institute of Technology in 1943, receiv[illegible] the degree of B.S. in C.E. His home wa[illegible] Philadelphia.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From November 10 to December 9, 1944, Inclusive

ADDITIONS TO MEMBERSHIP

AKSEL, ALI (Jun. '44), 605 East Daniel St., Champaign, Ill.

ALBALA, HIRAM ALBALA (Jun. '44), Nor-Lea Apartments 2, State College, Pa.

ALTAY, SAKIP MEHMET (Jun. '44), Research Asst., Univ. of Illinois, 114 Talbot Laboratory, Urbana (Res., 605 East Daniel St., Champaign), Ill.

AMENT, CHARLES DANA (Assoc. M. '44), Design and Constr. Engr., Eng. Div., Dept. of Public Works, 120 North Howard St. (Res., 1248 North Everett St.), Glendale 7, Calif.

ANDERSON, WILLIAM WILLARD (Assoc. M. '44), 2d Lt., San. Corps, U.S. Army, Medical Dept., Air Corps, Squadron F, Malden Airfield, Mo.

AUGER, SAMUEL BENNETT (Jun. '44), With U.S.N.; 1003 North 19th, Boise, Idaho.

BARNES, HERSCHEL DON (M. '44), Asst. Gen. Auditor, C. & N.W. R.R., 400 West Madison St., Room 1100, Chicago 6, Ill.

BARROWS, RAYMOND JOHN (Assoc. M. '44), Cons. Engr., Antilla Sugar Estates, Central Baguanas, Oriente, Cuba.

BARTLETT, FORD (M.'44), Pres., Lockwood, Kessler & Bartlett, Inc., 32 Court St., Brooklyn 2, N.Y.

BATES, THOMAS ISAAC, JR. (Jun. '44), Airways Engr., Dept. of Commerce, Civ. Aeronautics Administration, Section 53, 84 Marietta St., Atlanta, Ga.

BENEDICT, ARTHUR HAROLD (M. '44), Dist. Engr., Asphalt Inst., 523 West 6th St., Los Angeles 14, Calif.

BENSON, HARRY WINCHESTER, JR. (Jun. '44), Ensign, U.S.N.R.; 3731 Seventeenth Pl., N.E., Washington, D.C.

BEYER, HERBERT WILLIAM (Jun. '44), 325 North 11th St., Sabetha, Kans.

BONDANI, ROLAND (Jun. '44), Seaman 1/c, U.S.N.; 1094 Bryant Ave., New York 59, N.Y.

BROWN, JACK DOUGLASS (Jun. '44), Ensign, CEC, U.S.N.; 240 North 5th St., Slaton, Tex.

BRUCE, HENRY CLAY (Assoc. M. '44), Associate Engr. (Civ.), U.S. Dist. Engr. Office, Box 1739 Wright Bldg., Sacramento, Calif.

BURMEISTER, WALTER LOUIS (Assoc. M. '44), Office Engr., Bureau of Street Constr. and Repairs, Dept. of Public Works, City Hall (Res., 2010 South 28th St.), Milwaukee, Wis.

BUTWIN, GEORGE ROBERT (Jun. '44), Box 157, Sellyville, Ind.

CALABRA, JAMES, JR. (Jun. '44), 2d Lt., Corps of Engrs., U.S. Army; 205 Madison St., Rochester, N.Y.

CANNON, JACQUE WALTER (Jun. '44), 102 Shed[illegible] doah Rd., Hampton, Va.

CARAMIHAS, ANDREW THOMAS (Jun. '44), [illegible] ect Stress Engr., Goodyear Aircraft C[illegible] (Res., Y.M.C.A., 80 West Center St.), Akr[illegible] Ohio.

CARMAN, CHARLES BLOOMFIELD (Assoc. M. [illegible] 51 Concord Ave., N.W., Apt. 2, Washing[illegible] D.C.

CARTER, JAMES LEWIS (Jun. '44), With [illegible] Army; 213 Adams Ave., McGehee, Ark.

CHRISTENSEN, CHARLES WERNER (M. [illegible] Engr., U.S. Engr. Office, Clock Tower, R[illegible] Island, Ill. (Res., 2405 Tremont Ave., Da[illegible] port, Iowa.)

CLAUER, CALVIN ROBERT (Assoc. M. '44), In[illegible] Dept. of Military Topography and Graph[illegible] (Res., Quarters 2-11, U.S. Military Acade[illegible] West Point, N.Y.

DALTON, JACK JUNIOR (Jun. '44), Private [illegible] Class, U.S.M.C.; 566 Thirty-First St., Ogd[illegible] Utah.

DAVIES, ROBERT LLOYD (June. '44), Junior M[illegible] Engr., The David W. Taylor Model B[illegible] Navy Dept., Washington, D.C. (Res., [illegible] Fidler Lane, Silver Spring, Md.)